AFRICAN UNION

Semi-Arid Africa Agricultural Research and Development (AU/SAFGRAD)

Collaborative Striga research and control program in Africa

Funded by the Government of the Republic of Korea through
the International Agricultural Research Institute (IARI) of Kyungpook National
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About SAFGRAD

The Semi-Arid Food Grain Research and Development of the African Union (AU /SAFGRAD) was established in 1977 to advance agricultural research, development and natural resource management in the semi-arid ecology in more than 30 countries in sub-Saharan Africa. For more than three decades AU/ SAFGRAD has mobilized scientific talents and resources of National Agricultural Research Systems and those of International Agricultural Research Centres (IARC's) to enhance food security and sustainable agricultural deve-lopment in semi Arid zones of Africa.

Today, as a specialized office within the department of Rural Economy and Agriculture, SAFGRAD effort are garnered toward the support in the implementation of African agricultural agenda as embodied in the CAADP, the Sirte declaration with an emphasis on semi-arid zones. SAFGRAD has revitalized and broadened its programs to respond to the challenges of production increase, poverty alleviation, protection of the environment and mitigating the effect of climatic change.

SAFGRAD seeks to enhance livelihoods in the semi-arid areas through:

1. Facilitation of demand-driven research with the view to increasing production and productivity of land and water. This includes the packaging and dissemination of more productive and environmentally friendly technology packages.
2. Facilitating access to production and financial services.
3. Facilitate linkage of production to local and export markets as well as the transformation of produces into value added products.

The main thrusts of SAFGRAD's program are to:

i. Enhance agricultural research and demand/access of research outputs of member states through capacity building;

ii. Facilitate addressing agricultural policy issues through conferences, workshops, symposia and governmental contacts;

iii. Facilitate the industrial transformation and utilization of food grains into value-added products;

iv. Promote productive agriculture and environmental conservation through an integrated farming systems;

v. Build the knowledge base on semi-arid agriculture in SSA through its publications, specialized seminars etc

EXECUTIVE SUMMARY

In 2007, striga control activities under the project were carried out in six countries where activities were carried out in 2005 (funded activities were not carried out in 2006 due to late receipt of funds from the funding government, although some countries managed to implement some level of activities). These included Benin Republic, Burkina Faso, Cameroon, Ghana, Mali and Nigeria. In general, activities were a continuation of those carried out in 2005 namely (i) farm level implementation of promising striga control technologies in communities where farmers have had the opportunity of observing the effective technologies in demonstration trials, (ii) implementation of demonstration trials in new communities, (iii) on-station and community seed production, (iv) training of extension agents and farmers, and (vi) monitoring tour.

In 2007, a total of 2665 farmers were reached in the six countries compared to 2073 in 2005 and 1973 in 2004. The technologies demonstrated were Striga Tolerant and Resistant (STR) maize varieties cultivated sole in or an intercropping/rotation system with legumes such as cowpea and soybean. The legumes serve as trap crop, helping to bring down the striga seed population in the soil and also helps to enrich the soil with nitrogen through the activities of nitrogen-fixing bacteria. Overall, STR maize varieties showed clear superiority over local maize varieties. Varieties referred to as local are those being cultivated by farmers which in themselves may have resulted from formal plant breeding activities but have not been specifically improved for striga tolerance and resistance. Superiority of the STR maize varieties over the farmers' varieties was in the range of 16 to 60% (Average = 36%) in four countries for which reliable data were available as at the time of putting together this report. In addition to its yield superiority it was evident from the 2007 results that the STR varieties had fewer emerged striga plants, with the greatest reduction obtained in the moist savanna of Nigeria. Averaged over the four countries, there was a 60% reduction in the number of emerged striga plants achieved by the STR varieties. It is commendable that the activities for the project moved to new areas in some countries. This is important for maximum impact generation.

The year 2007 was of particular challenge in a number of countries because of the simultaneous occurrence of drought and striga. Each of these stresses on their own can wreck substantial havoc and when they occur together the effect can be devastating. This was the experience in Burkina Faso, Ghana and Mali. The joint occurrence of biotic and abiotic stress helps to explain the low yields obtained in these countries.

Farmers remain the best propagators of working and workable technologies once they are convinced. While a considerable level of success has been achieved in some countries in respect of technology diffusion involving the packaging and distribution of 2 to 3 kg of seed to farmers in highly infested areas, such impact is yet to be demonstrated in other countries. One way to achieve this is to strengthen the project executing team by involving breeders wherever the latter has not been involved. Given length of time the project has been running, ensuring the availability of seed for such an important component of the project as technology diffusion is crucial.

The lack of funds/late arrival of funds for the execution of the project in 2006, no doubt, affected the momentum of the project in 2007. This should be guarded against in the future since experience has shown that build-up of momentum is usually slow after such breaks, as was observed in Ghana. Activities carried out in 2007 by some countries did not agree with the activities contained in their proposals, for example Benin.

Monitoring tour was carried out by the two SAFGRAD Consultants on the project Dr. Charles The and Dr. Victor O. Adetimirin and Dr. Mahama Ouedraogo –SAFGRAD's Research and Program Officer. Dr. The visited Benin Republic and Ghana while Dr. Adetimirin visited Burkina Faso and Mali. Dr. Ouedraogo joined Dr. Adetimirin in the visit to on-farm sites in Fada N'Gourma, one of the two regions visited in Burkina Faso.

It is regrettable that reporting standard of activities carried out fell short of expectation, with important data not included in the reports. Consequently such data could not be included in this annual report. In this regard, the performance of Cameroon and Nigeria is particularly commendable.

During the year, the project lost one of its most dedicated scientist, Dr. Ibrahim Kureh in a road accident. Dr. Kureh was at the Review and Planning Workshop Meeting for 2007 held in Ouagadougou. The project will certainly miss his enthusiasm, dedication and commitment. In honour of the memory of our colleague, all hands must be on deck to combat this menace of a weed called striga. May Ibrahim Kureh's soul rest in peace•

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I. INTRODUCTION

Weeds pose enormous challenge to farmers and agricultural production. This is because they compete with crop plants for space, nutrient, water and sunlight. For this reason, a significant part of production cost is accounted for by activities associated with weed control. When weeds provide not only such competition but parasitize crop plants, the challenge becomes one of survival for farmers and their families. This is the story of the parasitic weed striga which has many species in Africa. Given the wide distribution of *Striga hermonthica*, it is understandable why a lot of effort has been devoted to its control.

West and Central Africa accounts for 43% of the African population and has one of the lowest nutrition rankings among all sub-regions of the world. The sub-regions is also one of the most hit by the striga problem. In effect, the resource poor farmers of the regions do not have the wherewithal to implement expensive control strategies for the parasite. It is an appreciation of this background that informed the strategy being employed in this project. The strategy is to keep the options for control of the parasite simple, inexpensive and easily adaptable. Striga tolerant and resistant varieties belong to this group of control option. It has been expressed that tolerant and resistant varieties remain the most benign control option for striga in Africa because they add little or nothing to the cost of production beyond the cost of procuring the seeds. The agronomic management practices of legume rotation and intercropping with cereals are other options that meet these criteria. Integrated striga control strategy, which involves combination of two or more methods are known to give better control of the parasite. However, use of tolerant and resistant varieties is central to any integrated control strategy.

The seed industry in West and Central Africa is not well developed. Many countries do not have a crop variety-release system, neither do they have a working seed industry. Given the importance of improved seeds in the control of striga, there is the urgent need to facilitate a seed production system in West and Central Africa to make available to farmers the results of decades of striga research. While improvement in striga tolerance and resistance levels are being pursued by several national and international institutes, we believe that varieties with levels of tolerance and resistance high enough to limit the damage of the parasites have been developed through various collaborative initiatives. As new and better varieties become available these can replace those being currently promoted for adoption by farmers. Through this approach farmers can start to reap the benefits of the huge investments in striga research over the past decades. Community seed production schemes appear to be a useful scheme under the present circumstances. A strengthening of the current community seed production system as practiced in Cameroon and its adoption in other countries offers hope. The experiences of this project in the countries currently participating would be useful to other countries that would be joining the project in 2008◆

II. ACTIVITIES AND ACHIEVEMENTS

2.1. REVIEW AND PLANNING WORKSHOP

In 2007, the review and planning workshop was held on 22 June, 2007 at the SAFGRAD Office in Ouagadougou. The meeting was chaired by Dr. Abebe Haile Gabriel, Director of SAFGRAD. It was attended by 16 scientists from 12 countries in two continents namely Benin, Cameroon, Burkina Faso, Ghana, Cote d'Ivoire, Ethiopia, Mali, Niger, Nigeria, Korea, Sudan and Zambia. The presence of Dr. Soon Kwon Kim from the International Agricultural Research Institute (I.A.R.I.) of Kyungpook National University (K.N.U.) was greatly appreciated.

The objectives of the planning meeting were to:

(i) Come up with the project strategy for the coming years.

(ii) Review of country activities proposed for 2007 by participants.

(iii) Consider the activities so far carried out in the project and draw out the lessons for better control of striga in Africa.

Dr. Abebe Haile Gabriel gave the opening remarks and thrust of the project. In his address to the participants, he observed that striga remains a problem in most parts of Africa. He remarked that while NARS will set the agenda and implement striga control technologies, SAFGRAD will facilitate mutual learning, sharing of experiences and provide the platform for generating impact. He also indicated that the government of the Republic of Korea may be willing to increase the level of funding of the project. In addition to the countries currently executing the project in West and Central Africa, six new countries expressed their interest in being part of the project. These countries include Ethiopia, Sudan, Niger, Zambia, Malawi and Botswana.

Project Strategy for Past and Coming Years

A presentation of the above title was made by Prof. Soon Kwon Kim. Major highlights of the presentation as listed below:

- A variety that shows high resistance, demonstrated by low striga emergence, must have high high yield potential to be of any value in infested areas. This is one of the key issues contained in the two papers Prof. Kim circulated during second day (Thursday, 21 June 2007) of the Consultative Meeting on Building Alliance for Striga Research and Control for Enhanced Food Security in Africa.

- While the on-going project would like to include sorghum, the resistant/tolerant materials currently available do not demonstrate resistance to a wide range of locally prevalent pests and diseases as in maize. This is one reason why striga-resistant varieties cannot be developed 'off-shore'. The project will support the extension of stably high yielding and adapted sorghum varieties.

- Farmers must be allowed to select the legumes of preference in a maize-legume intercropping or rotation system. Although cowpea features prominently in the control technologies being currently extended to farmers, its susceptibility to pests and disease that necessitates spraying without which complete yield loss may occur, is a problem.

- The integration of livestock into the technologies being currently extended to farmers should be encouraged because all strategies that have the capability to improve soil fertility will ultimately impact positively on level of striga infestation as well as yield improvement under the parasite.

Funds from the Korean government for the execution of the current project is NOT for research.

The project aims at controlling striga in Africa, not to eradicate it. Any strategy aimed at eradicating striga from Africa is not only **overambitious, unscientific but also unrealistic**. This is because Africa is the Centre of Origin of striga, with many alternative wild hosts, in addition to food crop hosts. If striga does not reproduce on food crops, it will reproduce on the wild hosts, which in many cases grow on fields adjoining those planted to food crops, and thereafter re-infest crop fields.

Subsequently, Prof. Kim will push on increased funding from the Korean government to about $1 m. The basic understanding that got the Korean government committed to the program is that the technologies being promoted will not involve the use of chemicals and would be environment-friendly.

Efforts need to be made to get the results of the on-farm demonstration published in scientific journals that are listed in the Science Citation Index (SCI). While the effort of Dr. Abdulahi in publishing results obtained in Ghana in a Pakistan journal is commendable, publishing in SCI journals should be prioritized.

There should be timely submission of report, even if interim, to be able to secure regular funding for the project. The lateness in securing funds for the project in 2006 should be seen as an opportunity to test the sustainability of the project.

The initiative to combat striga in Africa should translate to improved economy for African countries, given that maize is now a new source of energy, through the production of ethanol. For ethanol production, dent maize is most useful. Dent maize is also good for livestock. The environment for corn production is much better for West and Central Africa than in many parts of the world. Algeria is currently exploring sourcing water from between 200 to 1000 m depth to produce maize for ethanol production.

Overview of Practices and Lessons Learned in Striga Control in West and Central Africa

A presentation was made to address the above. The presentation was in two parts, each made by Drs. Charles The and Victor Adetimirin – the two consultants on the project. The major highlights of the presentation and comments generated are given below:

Charles The, *Maize Breeder*

It is important to continue to use varieties appropriate for ecological zone in terms of maturity group.

Scientists in the various countries should endeavour to meet up with the schedule for submission of reports for timely preparation of annual reports to be able to secure funding.

Victor O. Adetimirin, *Plant Breeding*

There is need to arrange for newly participating countries to visit on-farm demonstration in countries that have good trials in 2007.

Farmers reached through the project should include those who participated in the farmers' field day as well as those who benefited from distributed seed packages.

New countries joining the project should take reports of the demonstration trials over the years to familiarize themselves with the approach and strategies used in the project.

Arrangement is being made to get two papers on the project published. One would be an overview of the project and the strategies employed. The other would contain empirical data of impact generated. The draft of the first paper should be ready within four months of the planning meeting (i.e. October).

Prof. Soon Kwon Kim, *DG IARI*

For mid-altitude areas as found in Zambia, crosses can be made between lowland STR materials and mid-altitude adapted materials for the development of varietal crosses that are tolerant and resistant to striga. Mid altitude areas in Ethiopia can use the initiatives already suggested for Zambia.

- Team work is very important for new comers, even if such people have limited knowledge on striga.
- An award can be given to the country with the best demonstration.
- Countries with the worst demonstration can be dropped to be able to concentrate on more serious ones.
- The consultants need to carry out initial tour to determine which countries with good trials the new participating countries should visit during the 2007 monitoring tour.
- Each country should submit a small report of the activity that it undertook in 2006 when funding was not secured from the Korean government. Deadline for submission to SAFGRAD was fixed for 15 July 2007.

Proposed Activities for 2008

During the 2007 Review and Planning Workshop, participating NARS presented their annual work plan for the 2008 cropping season and extensive discussions were held to focus the activities for maximum impact. Details of the outcome of the Review and Planning Workshop are presented in another document (see Report of the Review and Planning Workshop for 2007).

Work Plan for 2007/2008

The following work plan was approved for implementation for the year 2007/2008:

1. Implementation of country projects; June 2007-December 2007.
2. Submission of project request to Korean Government: 31 August 2007.
3. Monitoring tour: Mid September to October 2007 (when striga emergence and attack are apparent in most countries).
4. Submission of country yearly reports (including photographs and other illustrations) to SAFGRAD Coordination Office: 15 January 2008.
5. Submission of project annual report and monitoring tour report to the Korean Embassy: 31 January 2008.
6. Review and Planning Meeting: First week of February 2008.
7. Submission of financial justification to SAFGRAD: 31 March 2008.

2.2. ON-FARM DEMONSTRATION OF STRIGA CONTROL TECHNOLOGIES

In the year 2007, a total of 2755 farmers were involved in the six participating countries compared to 2073 and 1973 in 2005 and 2004, respectively. These figures translate 33% and 40% greater farmer participation in 2007 than in 2005 and 2004 (**Table 1**). Across countries, the total number of farmers involved in technology demonstration and diffusion was 1817, a value 47% higher than the 2005 figure. In 2007, there was early disbursement of funds, and this could partly explain the higher number of farmer participation. When funds are released late, farmers put the land they have earlier earmarked for the demonstration to other uses. Fewer farmers were involved in the varietal trials in 2007 while more farmers implemented the demonstration of rotation as a strategy for controlling striga. This is probably due to the greater uncertainty with rainfall in recent past. With such uncertainty the cultivation of more than one crop helps farmers to spread out the risk such that complete crop loss is averted. In the 2007 cropping season, two countries (Benin and Burkina-Faso) used the farmers' field school strategy to demonstrate striga control technologies to 58 farmers. Community seed production was reported only in Cameroon, Burkina-Faso and Mali. In these countries, seeds to implement the various technologies should be available for 2008 trials. On-station breeder seed production was carried out in Cameroon, Burkina-Faso and Nigeria. Although field days were

Table 1. **On-farm Striga Research and Control Project in 2007**

ACTIVITIES	BENIN[a]		BURKINA FASO		CAMEROON		MALI		GHANA		NIGERIA		TOTAL	
	N° of villages	N° of farmers	N° of villages	N° of farmers	N° of villages	N° of farmers	N° of villages	N° of farmers	N° of villages	N° of farmers	N° of villages	N° of farmers	N° of villages	N° of farmers
Variety demonstration Trials	-	-	13	15	12	37	4	24	-	-	-	-	29	76
Rotation demonstration Trials	-	-	2	7	8	16	-	-	1	20	6	52	17	95
Intercropping demonstration	-	-	-	-	-	-	-	-	1	20	-	-	1	20
Diffusion	-	-	1	50	29	605	-	-	-	-	6	892	36	1 547
Farmer's Field school	3	21	-	37	-	-	-	-	-	-	-	-	5	58
Sub-total		**21**	**-**	**109**	**-**	**658**	**-**	**24**	**-**	**40**	**-**	**944**	**-**	**1 796**
Seed production														
• On station	NA	-	-	NA	-	NA	-	NA	-	NA	-	NA	-	-
• On farm	-	-	2	3	6	25	2	2	-	-	2	2	12	32
Field Days	-	-	-	-	2	187	1	500	-	-	-	-	3	687
Training / Meeting	-	-	?	28	3	100	-	-	1	70	-	-	4	198
Survey	-	-	-	-	-	-	-	-	-	-	2	20	2	20
TOTAL **2007**	4	22	13	140	12	970	4	526	3	110	6	987		2 733
" **2005**	9	48	3	202	9	612	2	212	3	138	6	861		2 073
" **2004**		622		42		651		25	-	-		557		1 973
2003		87		23		721		26	-	-		173		1 943
GRAND TOTAL		**779**		**407**		**2 954**		**789**		**248**		**2 578**		**7 755**

[a] = Sub-totals were not computed for number of villages to avoid overestination because more than one activity often take place in a village

[b]= NA: not applicable

recommended for all countries, it was only carried out in Cameroon and Mali. In Cameroon, Ghana and Burkina Faso, a total of 178 farmers were trained to conduct field activities on striga control technologies. It was only in Nigeria that farmers' assessment of the various striga control technologies was carried out.

In 2007, STR maize varieties demonstrated in the project numbered 18. These included six extra-early STR varieties (**Table 2**) as well as later maturing varieties with grain texture and colour suited to various agro-ecological situations and farmers' preferences. Six cowpea genotypes were used in the rotation and intercropping trials. Germplasm continues to be exchanged among NARS scientists. Five of the six participating countries used the maize variety Across 94 TZE Comp 5-W. Cowpea variety TVX 1850-01 F from Benin was used in Cameroon as well as KVX-61-1 from Burkina-Faso. Three soybean varieties and one groundnut cultivar were utilized in 2007.

2.2.1 On-farm Variety Demonstration

A total of 76 farmers were involved in on-farm variety demonstration compared to 175 in 2005. This activity was carried out in 29 villages, a number more than twice that for the activity in 2005. The increase in the number of villages reached, among other reasons, was due to the timely release of funds for the various activities. In contrast to the situation in 2005, participating NARS spread out their activities to more villages but reached fewer farmers compared to what obtained in 2005. This appears to be due to the fact that funding for the various activities remains unchanged. For the variety demonstration trials, each variety was planted on a 20 m x 20 m plot in areas known to be infested with striga. The results obtained from the fields of 76 farmers in three countries are presented in **Table 3.**

Yield increase of the STR varieties over those of local varieties averaged 36% with a range of 16% obtained in the Guinea savanna of Cameroon to 64% in the moist savanna of Nigeria. These results showed some agreement with those of 2005. Striga incidence was not very high in 2007 and ranged from 1603 emerged striga plants in the Guinea savanna of Nigeria to 36535 in the moist savanna, also in Nigeria. The higher striga counts were usually obtained on the farmers susceptible varieties. Across ecological zones, number of emerged striga plants on STR varieties was 5735 per hectare compared to 15028 on farmers' varieties. Thus, reduction in emerged striga plants achieved by STR varieties was 61%. The reduction achieved by STR varieties in 2005 was 74%. A number of factors influencing striga emergence and the difference between the percentage reduction in 2005 and 2007 can be considered of little consequence, especially given that the varieties used in the two years were, to a large extent, similar. These results further confirm that the advantage of STR maize varieties over susceptible varieties transcend yield increase but extends to reduction in actual number of the parasite that emerges on maize. With the exception of Burkina Faso, the maize grain yields obtained in the various countries were higher than values obtained in 2005. One possible reason for this is better management as a result of the experience gained over the years.

2.2.2 On-farm rotation trials

A total of 95 farmers were involved in on-farm rotation trials this year compared to 15 in 2005. In all 17 villages were used, with all the trials being in their first year, except in Nigeria where some rotations have progressed beyond their first year. Again, the increase in the number of participating farmers can be attributed to the early engagement of farmers by NARS, which in turn resulted from the early release of funds by SAFGRAD. The results obtained from three countries that participated in this activity in 2007 are presented in **Table 4.** In Ghana, grain yield of both the STR maize and the local check were less than 1.00 t ha^{-1}. STR maize grain yield was 3.53 t ha^{-1}. In this first year of rotation, maize grain yield of STR varieties ranged from 0.85 t ha^{-1} in Ghana to 3.53 t ha^{-1} in the Guinea savanna of Cameroon. Maize

Table 2. **Technologies Demonstrated in Participating Countries in 2007**

PARTICIPATING COUNTRIES	STR MAIZE NAMES	GENETIC STRUCTURE	COWPEA NAMES	SOYBEAN NAMES	GROUNDNUT NAMES
BENIN	Across 94 TZE comp5-w	Early Composite	TVX 1850-01F	Jupiter	---
BURKINA FASO	Across 94 TZE comp5-w	Early Composite	KVX 369-4-5-2D	G196	
	Across 94 TZE comp5-y	Early Composite	KVX 61-1		---
	SR 21	Intermediate composite			
	SR 22	" "			
	Wari				
	TZEE-w pop STR QPM	Extra-early and High Protein			
	TZEE-y pop STR QPM	" "			
	TZEE-y pop STR QPM	Early and High Protein			
	TZEE-w pop DT STRQPM	Early drought tolerant and high protein			
MALI	Across 94 TZL-w	Intermediate composite	Dalabani	--	
	EVDT-97 STRC1	" "			
CAMEROON	Advanced NCRE STR	Intermediate Synthetique	TVX 1850-01F		
	Cam Inb STR	" "	KVX 61-1		
	STR-y	" "	Lori1		
	K9351 STR	" "			
	CMS 8501	Intermediate Composite			
	Syn 2000 EE-w	Extra-early Synthetique			
	TZEE-w-STR	Extra-early Composite			
GHANA	Across 94 TZE comp5-w	Early Composite Intermediate Composite			
	Across 97 TZL comp1-w				
NIGERIA	Across 97 TZL comp1-w	Intermediate Composite	IT93K452-1	TGX 1448-2E	RMP 91

Table 3. **CropPerformance in On-Farm Variety Demonstration Trials in 2007**

PARAMETERS	TECHNOLOGIES DEMONSTRATED	CAMEROON		BURKINA FASO	NIGERIA		MALI	MEAN[a]
		Guinea Sav.	Sudan Sav.		Moist Sav.	Guinea Sav.		
- Maize Grain Yield	- STR Maize varieties	3 071		608	2 883	2 105	--	**2 791**
Kg ha-1	- Farmer's Maize	2 656	3 104	425	1 761	1 441	--	**2 048**
	- STR maize as		2 334					
	% Farmer's Maize	116		143	164	146	--	**136**
			133					
- Number of Striga	- STR Maize	5 050		--	8 650	1 603	--	**5 788**
Plants emerged ha-1	- Farmer's Maize	9 600	7 850	--	36 525	2 485	--	**15 028**
	- STR maize as		11 500					
	% Farmer's Maize	53		--	24	65	--	**39**
			75					
- Plant Density	- STR Maize	39 638		--	26 073	--	--	**34 870**
	- Farmer's Maize	33 210	38 900	--	25 125	--	--	**30 152**
	- STR maize as		32 122					
	% Farmer's Maize	119		--	104	--	--	**116**
			121					
- Crop Damages	- STR Maize	--	--	4.0	--	--	--	**4.0**
Reaction (score 1-a)	- Farmer's Maize	--	--	6.0	--	--	--	**6.0**
	- STR maize as							
	% Farmer's Maize	--	--	67	--	--	--	**67**

Table 4. **Performance of component crops in on-farm rotation demonstration in 2007**

PARAMETERS	TECHNOLOGIES DEMONSTRATED	CAMEROON		GHANA	NIGERIA	MEANS
		Guinea Sav.	Sudan Sav.			
Maize grain yield kg/ha⁻¹	- STR Maize alone	3 528	3 477	550	2 554	1 552
	- - STR Maize after legumes	--	--	--	3 279	3 427
	- Farmer's variety	2 111	2 993	350	848	
	- STR maize as % Farmer's variety	167	116	157	344	1 576
						160
Number of Striga plants Emerged ha⁻¹	- STR Maize alone	7 050	5 350	775	7 300	4 038
	- STR Maize after legume	--	--	--	4 413	5 604
	- Farmer's maize variety	9 980	8 850	11 920	33 013	13 441
	- STR maize as % Farmer's maize variety	71%	60	40	18	36
Plant density	- STR Maize alone	37 810	-39 330	--	37 147	37 147
	- STR Maize after legume	--	--	--	27 167	34 769
	- Farmer's maize variety	32 206	34 510	--	26 660	31 125
	- STR maize as % Farmer's maize variet	117	114	--	121	116
Legume grain yield (kg/ha⁻¹)		565	610	1050	1 053	742

grain yield superiority of the STR varieties was 244% better that yield of the local check. On the average, STR maize alone out-yielded the farmers' variety by 60% compared to 85% obtained in 2005 when maize plants following legume benefited from improved soil fertility and lower infestation, two benefits of legume cropping in striga infested areas. Numbers of striga plants were also lower on the STR varieties used. About 70% more striga plants were found on the farmers' varieties. The effect of legume intercropping on grain yield and number of striga plants can only be evident in the second and third years of the rotation trials. A mean grain yield of 0.74 t ha^{-1} was obtained for the legumes. In Nigeria where maize was planted sole in plots previously cultivated to groundnut, the STR maize yield was 25% better than the yield obtained from the STR maize grown in a plot previously cultivated to the same STR maize.

2.2.3 On-farm maize-legume intercropping

It was only in Ghana that intercropping was carried out in 2007 and this involved 20 farmers. The results are presented under Ghana's country report in this publication. Although maize grain yields were low because of the peculiar difficult rainfall distribution during the season, one major effect observed was the considerably lower number of striga plants in plots planted to STR maize, whether sole or intercropped with legume, compared to similar plots planted with the farmers' varieties. The yield of the legume in STR and non-STR maize plots were comparable.

2.2.4 Technology Diffusion

Technology diffusion consisted mainly of packaging and distributing 2 to 3 kg of STR maize seeds and/or seeds of legumes to farmers in areas with the striga problem. Participating countries were encouraged in 2005 to implement this activity as it represents one way to scale up the impact of the project. However, diffusion implies that the implementing countries have made provision for adequate seed production. In general, on-station production of seed for diffusion appears to be strong in countries with plant breeders in the team and weak in countries without any breeder such as Benin. Farmers were advised to plant the distributed maize seeds sole or in an intercropping or rotation system with legumes, depending on their crop production system preference. The total number of farmers reached with this strategy was 1796 which represents a 79% increase over the farmers reached in 2005. A total of 50 farmers were reached in Burkina Faso, while 605 and 892 farmers were reached in Cameroon and Nigeria, respectively.

2.2.5 On-station and on-farm seed production

During the consultative meeting held in Ibadan from 7-9 June, 2005 and during the review and planning workshops of 2002, 2003, 2004, 2005 and 2007, these activities were recommended for participating countries. It is expected that countries that have implemented the project for several years should appreciate these activities and also possess the expertise for their implementation. These seeds produced from these activities drive the implementation of the whole project. For the community seed production on-farm, the activity ensures community involvement in the project and makes for sustainability when the project comes to an end. With the exception of Ghana, Benin and Mali, participating countries were able to produce considerable quantities of seeds of the crops being used in the project. The seeds produced for each crop varieties in 2007 are shown in **Table 5**. A total of 7775 kg of maize seed and 540 kg of legume seed were produced. These values represent 7% and 70% lower seed production for maize and legumes, respectively, in 2007 compared to 2005. The poor rainfall distribution pattern severely affected this activity in Burkina Faso and Ghana. On station maintenance of seeds of the STR maize varieties was carried out in Burkina Faso, Cameroon and Nigeria using the half sib method. A total of 110 kg of seeds of leguminous trap crops were produced on-station in 2007.

Table 5. **Quantity of STR-Maize and legume seed producec in 2007**

COUNTRY	CROPS	VARIETY	ON-STATION	ON-FARM (kg)	Yield ($kg.ha^{-1}$)
BURKINA FASO	Maize	Across 94 TZE Comp5-Y	--	775	388
		Across 94 TZE Comp5-W		600	600
CAMEROON	Soybean	G196		185	370
		KVX396-4-5-2D		203	406
		KVX 61-1		152	304
	Maize	Advanced NCRE STR	180 Families	2 400	1 200
			100 kg ?	--	--
			50 kg ?	--	--
		STR-y	125 Families	1 200	800
			100 kg ?		
		Cam Inb STR	98 families	1 600	1 067
	Cowpea		50 kg females		
		K9351	50 kg females	1 200	1 200
		TVX 1850-01 F	50 kg	--	--
		KVX 61-1	60 kg	--	--
GHANA					
	Maize	Across 97TZL comp 1-w	40 kg	--	--
		GH 120 DYDF	40 kg	--	--
NIGERIA (Sudan Savanna)	Maize	Across 97TZL comp 1-w	600 Families	--	--
				--	--
NIGERIA (Moist Savanna)	Maize	Across 97TZL comp 1-w			
	Legume	RMP 91		--	--
TOTAL	**Maize**	**STR-Maize**	**1 003 families**	**7 775**	**864**
			300 kg Females	**--**	
	Legume		**110 kg**	**540**	

2.2.6 Farmers' perception of project technologies

In general farmers indicated preference for the STR varieties and the legumes being promoted during the project. The reports by countries in respect of the preference were confirmed during the monitoring tours carried out. A formal study of the perception of technologies being promoted by farmers was carried out only in northern Nigeria in 2007. Reasons for the preference of the varieties being promoted include higher yield of the STR maize varieties with or without striga and fewer emerged striga plants. The most favourable reports of the performance of STR varieties were, however, received in areas with heavy striga infestation.

2.2.7 Training

Training conducted during the 2007 cropping season was carried out for extension agents and farmers implementing the demonstration trials through the farmers' field school approach. Farmers were also trained in community seed production in Benin, Burkina-Faso, Cameroon and Nigeria. The training covered seed multiplication techniques with emphasis on plot isolation, removal of off-types, seed handling, storage and marketing. Farmers were also trained in how to assess striga damage on maize, the use of trap cropping and how to prevent striga seed dissemination. In 2007, a total of 130 farmers were trained.

2.2.8 Economics of demonstrated technologies

In 2007, a survey on the economics of demonstrated STR varieties was carried out only in Nigeria. The results obtained for this study are presented under this country's report. In general it was more profitable to cultivate STR varieties as the results showed a high return to investment than return for the farmers' varieties◆

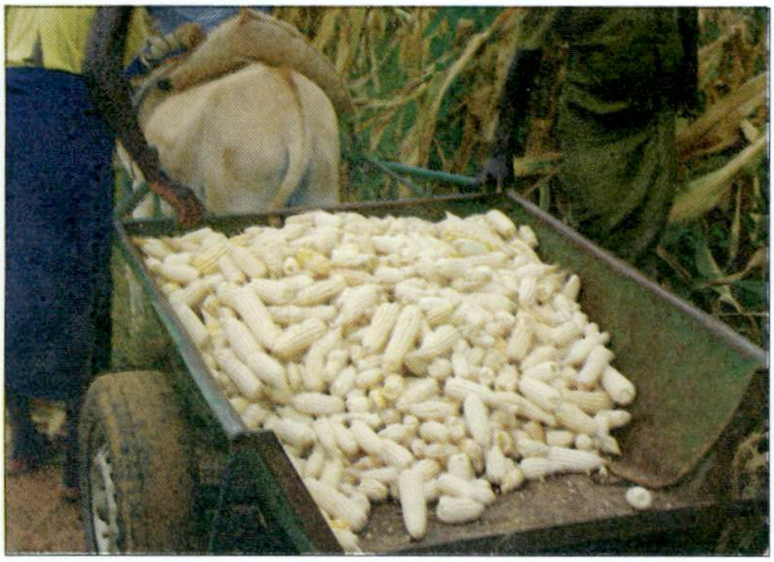


Table 6. Economics of STR maize cultivation in 2007 in northern Nigeria

ZONES	ITEMS	TOTAL VARIABLE COST	GROSS REVENUS	GROSS MARGIN	RETURN TO NAIRA
AN Savannaa	Improved STR Maize	48 991.6	127 560	78 569.0	1.52
	Farmer's variety	47 474.3	86 040	38 565.7	1.21
GUINEA Savannab	Improved STR Maize	88 000	208 250	120 250	1.37
(Moist)	Rotation	124 750	386 705	261 955	2.10
	Farmer Practice	77 750	91 475	14 275	0.19

[a]: Mean for 3 locations; [b]: Mean of 2 locations

III. SCIENTIFIC MONITORING TOUR

Monitoring tours were carried out in Benin, Mali, Burkina-Faso and Ghana. Dr. Adetimirin visited Burkina Faso from 24 to 27 October, 2007 to assess the trials conducted by Dr. Jacob Sanou and Oumar Ouedraogo of INERA. The visit involved trips to Fada N'gourma (Dr. Mahama Ouedraogo also visited Fada N'gourma with Dr. Adetimirin) and Lena. In Fada N'gourma, the striga control technology demonstrated was implemented on one farm per village but with between 7 and 10 farmers having the opportunity of repeated visits to the farms with the control technologies for the purpose of comparing the demonstrated technology with performance on their farms. During the monitoring tour Dr. Adetimirin met with farmers engaged in the production of seeds of KVX 61-1 and KVX 396-4-5-2D on 0.25 ha per farmer. The visiting team interacted with 21 participating farmers who made themselves available for feedback on the demonstrated technology. In Lena, located 55 km from Bobo-Dioulasso, four types of activities were observed by Dr. Adetimirin and these are variety demonstration, on-farm rotation, seed production of STR maize and cowpea and training of farmers.

Dr. Adetimirin visited Mali from 29 to 31 October 2007. To kick-start the tour, Drs Adetimirin and Mr. Ntji Coulibaly met with Dr. Guindo, the Regional Director of l'institute D'economie Rural (IER). The locations visited had variety trials, intercropping trials and seed multiplication. Other details of this trip can be found in the monitoring tour report.

Benin and Ghana were visited by Dr. Charles The from 26 September 2007 to 8 October 2007. In Benin, Dr. Gualbert Gbehounou presented the following field activities: one farm owned by Mr. Madougou – a former participant in the farmers' field school, a soybean variety Jupiter seed multiplication plot and another seed multiplication plot of Across 94 TZE Comp 5-W, a farmers' field school consisting of 19 women and 2 men, and a trial comparing direct-seeded and transplanted sorghum. In Ghana, Dr. Abdulai provided information that trials in northern Ghana were already harvested as at the time of the visit. However, a 30 x 20 m seed multiplication plot of four varieties was visited. Visit was also done to a maize demonstration plot with four varieties viz. IWD-STR, Dodji, Suwan-1 SR and GH120 DYF.

IV. COUNTRY REPORTS

CAMEROON

INTRODUCTION

The general objective of the project in Cameroon is to sustain food security and alleviate poverty through the control of striga. In 2007, in Cameroon, the Striga control research activities under the project consisted of:

- Breeder Seed Maintenance
- Technology diffusion;
- On-farm variety trials;
- On-farm rotation trials;
- On-farm community seed multiplication;
- Roadside demonstration plots;
- Field day and
- Training.

On-Station Breeder Seed Maintenance

The 2007 cropping season was characterized by abundance of rain. Maintenance of breeder seed was carried out under artificial striga seed infestation but striga emergence was low, perhaps a consequence of the high rainfall. From 1998 to 2007, more than 3000 farmers in Guinea and Sudan Savanna have been exposed to IRAD striga-tolerant varieties. In Gatougel zone where considerable effort has been committed to the control of striga, more than 60% of the farmers in the zone have adopted the striga control technologies demonstrated, especially the STR maize variety - Advanced NCRE-STR. Consequently breeder seed of Advance NCRE and three other STR varieties (STR Yellow, K9351 and Cam Inbred) were produced. The quantities of breeder seed produced on-station as well as seeds produced by farmers under the community seed production system are indicated in **Table 5**. In all a total of 6.4 t of STR maize seed was produced. IRAD received 1.5 t of the produced seed as according to agreement to defray the cost of input provided.

STR maize diffusion

The unit distributed to each of 605 farmers 2 kg of STR maize of their choice (based on maturity cycle and color). The farmers were advised to plant the STR maize seeds on striga-infested parts of their field alongside their local varieties using cultural practices to which they were familiar. They could also plant cowpea between or near maize plants (intercropping) or in after maize in the following season (rotation). A survey was conducted after harvesting to obtain the farmers' perception of the technologies. The results were not available at the time this report was compiled.

On-Farm Variety Trials

In 2007, on-farm variety trials involved 37 farmers with each of the farmers provided with two out of three STR-maize varieties that were to be compared with their own varieties.

Maize genotypes used were extra early varieties TZEE-W, 2000 SYN E, TZEE-Y and a farmer's local variety in the Sudan Savanna zone and Advanced NCRE, K9351, STRY, compared to CMS 8501 in the Northern Guinea Savanna zone. Each variety was grown on 20 rows each measuring 20m. Farmers were advised to use only part of their farmland previously identified as having high striga infestation. Data collection was done by staff of the Ministry of Agriculture, assisted by the farmers and these include number of emerged striga plants on the two central rows, as well as number of maize plants, number of ears, and grain yield.

On-Farm Rotation Trial

On-farm rotation trials were carried out with newly recruited farmers in new villages. Sixteen farms were involved which consisted of three rotation treatments viz. (i) STR maize cropped consecutively for two seasons followed by cowpea in the third year, (ii) STR maize cropping alternated with cowpea, and (iii) continuous cropping of the farmer's maize variety (See diagram below). In the first and second rotation treatments, the STR maize varieties in the two seasons, whether following one another or interspersed by one season of cowpea cultivation, were different. The two maize varieties were Advanced NCRE-STR and K9351-STR. Similar data as in the on-farm variety trials were collected.

1st Year	STR_1	STR_2	Local Maize
2nd Year	STR_2	Cowpea	Local Maize
3rd Year	Cowpea	STR_1	Local Maize

On-Farm STR Community Seed Production

Twelve farmers in six villages were involved in this activity. A total of 13 former participating farmers from the 2004 season are, on their own, still continuing with this activity in their respective villages. The strategy used involved providing the farmers with 5 kg of breeder seed and fertilizer. Extension agents play the role of helping the farmers to select a good plot. Selected plots were isolated and off-types removed before flowering. At harvest, maize cobs are sorted into two viz. Class A - made up of big ears, and class B-made up of small ears. Farmers were instructed to sell the seeds obtained from the shelling of Class A cobs as seed, with IRAD having a right to a quarter of the Class A seed.

Field Demonstration and Field days

Two fields (50 m x 50) were marked out to serve as demonstration plots. The first one was located at the entrance of IRAD, Garoua Station while the second was in Djalingo. The Djalingo field was divided into two: the first under artificial striga infestation, and the second was striga-free. These plots were used for field days. The varieties demonstrated were STR-Y, Cam Inb STR Advanced NCRE STR, K 9351, TZEE–SR, and CMS 8501.

Training

Two training courses were conducted and sponsored by FAO. The courses involved 100 extension agents. The objective was to train extension agents who will supervise farmers involved in maize and seed cultivation. The numbers of extension agents that attended the course from the Guinea and Sudan savanna were 57 and 43, respectively.

RESULTS

A total of 970 farmers were reached in Cameroon in 2007(**Table 7**) consisting of 35 participating farmers in on-farm demonstration trials, 16 in on-farm demonstration trials, 25 in STR seed multiplication (13 out of which were continuing from the previous year's activities), 605 in the diffusion trials and 187 in the field days carried out on the demonstration plots.

ON FARM VARIETY EVALUATION AND ON FARM ROTATION TRIAL

Sudan Savanna zone

On-farm variety evaluation

The results obtained are presented in **Table 8**. The mean yield of the STR varieties ranged between 2.97 t ha^{-1} for TZEE-W and 3.3 t ha^{-1} for TZEE-Y while mean yield for the local variety was 2.33 t ha^{-1}. The yield superiority of the STR varieties was 33% higher than the grain yield of the farmers' variety. Average number of emerged striga plants supported by the STR varieties was 31.7% lower than the number of striga plants supported by the farmers' varieties. These results indicate that STR varieties are advantageous in terms of grain yield and the number of striga plants supported.

Table 7. Summary of 2007 on-farm striga research and control activities of Cameroon

Ativities	Agro-ecological Zones	Villages	Number of trials/farmers
on-farm variety evaluation	Sudan savanna	Bougaye	2
		Kalfou	2
		Toulam	2
		Kaele	2
		Mindif	2
		Ganai	2
		Gazawa	2
	Guinea savanna	Bame	4
		Dobinga	4
		Dadjam	4
		Filguil	4
		Gouna	4
		Djalingo	4
Sub-total			**37**
on-farm rotation trials	Sudan savanna	Kalfou	1
		Mindif	2
		Gazawa	1
	Guinea savanna	Bame	2
		Dobinga	1
		Mayo-bocki	1
		Dadjam	4
		Figuil	4
Sub-total			**16**
STR-seed multiplication	Sudan Savanna	Gazawa, Mindif, Kalfou	12
	Guinea Savanna	Djalingo, Bame, Dadjam	13
Sub-total			**25**
Diffusion trial	Sudan Savanna	13	300
	Guinea Savanna	16	305
Sub-total			**605**
Demonstration plot (for field days)	Sudan Savanna	Bockle	101
	Guinea Savanna	Djalingo	86
Sub-total			**187**
Training	Sudan Savanna	Maroua	43
	Guinea Savanna	Garoua	57
Sub-total			**100**
	GRAND TOTAL		**970**

On-farm rotation trials

The first year data for the rotation trials are presented in **Table 9**. The mean yield of the STR varieties was 3.5 t ha^{-1}, representing 67% higher yield than that of the local check. Considerable variation was observed in yield of the STR varieties from location to location with the highest yield of 5 t ha^{-1} obtained for the STR variety Advanced NCRE and K9351 in Kalfou. Averaged over the four locations used for the rotation trials in the Sudan savanna, grain yield was

Table 8. On-Farm variety evaluation trial in Sudan Savannah Zone

Site	Variety names	Number of farmers farmers	Grain yield kg ha^{-1}	%	Striga/plot (n°.)	%
Bougaye	TZEE-W	1	2567	103	210	68
	2000 SYN E	1	2900	116	150	48
	TZEE-Y	1	3167	127	160	52
	V. local	1	2500	100	310	100
Kalfou	TZEE-W	1	3000	112	182	88
	2000 SYN E	1	3167	119	164	80
	TZEE-Y	1	3833	144	170	83
	V. Local	1	2667	100	206	100
Toulam	TZEE-W	2	4392	155	96	80
	2000 SYN E	2	3333	118	82	68
	TZEE-Y	2	3667	129	87	73
	V. local	2	2835	100	120	100
Kaele	TZEE-W	1	2667	114	155	79
	2000 SYN E	1	2833	122	132	67
	TZEE-Y	1	3833	165	141	72
	V. local	1	2330	100	196	100
Mindif	TZEE-W	1	1833	138	222	81
	2000 SYNE	1	2167	163	187	68
	TZEE-Y	1	2500	115	172	58
	V. local	1	2170	100	274	100
Ganaï (Mora)	TZEE-W	1	3333	154	192	65
	2000 SYN E	1	4333	200	120	41
	TZEE-Y	1	2500	115	172	58
	V. local	1	2170	100	296	100
Gazawa	TZEE-W	1	3000	120	181	86
	2000 SYN E	1	2500	100	111	53
	TZEE-Y	1	4500	180	172	82
	V. local	1	2500	100	211	100
Grand mean	Mean improved	24	3104	133	157	68
	Mean local (CMS 9015)	8	2334	100	230	100
Mean variety	TZEE-W	8	2970	127	177	77
	2000 SYN E	8	3033	130	135	59
	TZEE-Y	8	3310	142	158	69
	V. local	8	2334	100	230	100

4.1 t ha^{-1} for Advanced NCRE, 3.0 t ha^{-1} for K9351 and 2.1 t ha^{-1} for CMS 8501, the variety considered as local. These results indicate the superiority of Advanced NCRE for striga control in the Sudan savanna zone. Even in the first year of this rotation, ahead of planting cowpea, the two STR varieties supported fewer striga plants than CMS 9015 (34% fewer under Advanced NCRE and 24% fewer under K9351).

Northern Guinea Savanna zone

On-farm variety evaluation

Mean yield of the STR varieties ranged between 2.6 and 3.6 t ha^{-1} (**Table 10**). It was in the order Advanced NCRE-Y > K9351 >STRY. On average, yield of the STR varieties was 33% higher than yield of CMS 8501 that served as the farmers' variety. These varieties, on average, also supported 47.4% fewer striga plants. In general, these results are somewhat similar to those obtained in the Sudan savanna.

On-farm rotation trials

Twelve farmers in five villages were involved in the on-farm rotation trials in the northern Guinea savanna. The two STR varieties Advanced NCRE and K9351 out-yielded CMS 8501 (taken as the local check) by 25% and 7%, respectively, with an average superior performance of 16% (**Table 11**). Again the superiority of Advanced NCRE in this ecological zone was clear. As was observed in the Sudan savanna, the two STR varieties also supported 46% and 33% fewer striga plants than CMS 8501, notwithstanding that 2007 was the first year of the rotation with no possible benefit from cowpea.

CONCLUSION

Although the Guinea savanna is considered to have the greatest potential for maize production in West and Central Africa, the mean yield obtained in the ecology for the variety trials was slightly lower than yield of the STR varieties in the Sudan savanna. This was due to the drought which occurred in the Guinea savanna zone about 40 days after planting. Superiority of the Guinea savanna zone was also not very evident in the rotation trials. In general, the results showed the cultivation of STR varieties to be superior in terms of higher yield and reduction in the number of emerged striga plants◆

Table 9. On farm rotation trial in Sudan Savannah Zone of Cameroon in 2007

Site	Variety names	Number of farmers	Grain yield	%	Striga/ plot	%
Kalfou	ADV	1	5000	231	140	75
	K9351	1	3167	146	155	83
	9015	1	2167	100	187	100
Mindif	ADV	2	4667	233	123	59
	K9351	2	2833	142	171	81
	9015	2	2000	100	210	100
Gazawa	ADV	1	2500	115	131	66
	K9351	1	3000	138	128	65
	9015	1	2167	100	198	100
Grand mean	Mean improved	8	3528	167	141	71
	Mean local (CMS 9015)	4	2111	100	198	100
Mean variety	ADV	4	4056	192	131	66
	K9351	4	3000	142	151	76
	9015	4	2111	100	198	100

Table 10. On farm variety evaluation trial in Northern Guinea Savannah Zone of Cameroon

Site	Variety names	Number of farmers	Grain yield	%	Striga/ plot	%
Bamé	Advanced NCRE-Y	22860	128	108	79	
	K9351	2	2150	96	82	60
	STR-Y	2	2165	97	75	55
	CMS 8501	2	2235	100	136	100
Dobinga	Advanced NCRE-Y	2	2830	126	181	64
	K9351	2	2580	115	169	59
	STR-Y	2	2165	96	105	37
	CMS 8501	2	2250	100	285	100
Dadjam	Advanced NCRE-Y	4	4690	153	110	52
	K9351	4	2780	91	105	50
	STR-Y	4	3000	98	96	46
	8501	4	3063	100	210	100
Figuil	Advanced NCRE-Y	4	3013	93	112	76
	K9351	4	2513	78	101	69
	STR-Y	4	2905	90	52	35
	CMS 8501	4	3233	100	147	100
Gouna	Advanced NCRE-Y	1	4380	175	88	48
	K9351	1	5170	207	55	30
	STR-Y	1	2870	115	72	40
	CMS 8501	1	2500	100	182	100
Grand mean	Mean improved	39	3071	116	01	53
	Mean local (8501)	13	2656	100	192	100
Mean variety	Advanced NCRE-Y	13	3555	134	120	62
	K9351	13	3039	114	102	53
	STRY	13	2621	99	80	42
	CMS 8501	13	2656	100	192	100

Table 11. On farm rotation trial in Northern Guinea Savannah Zone of Cameroon

Site	Variety names	Number of farmers	Grain yield	%	Striga/ plot	%
Bamé	ADV	2	3420	93	98	82
	K9351	2	2920	80	188	157
	8501	2	3665	100	120	100
Dobinga	ADV	1	4500	171	120	57
	K9351	1	2670	102	116	55
	8501	1	2630	100	210	100
Mayo- Bocki	ADV	1	3170	136	77	39
	K9351	1	3000	129	101	51
	8501	1	2330	100	198	100
Dadjam	ADV	4	3518	114	81	40
	K9351	4	3980	129	76	38
	8501	4	3088	100	201	100
Figuil	ADV	4	4128	127	101	65
	K9351	4	3460	106	113	72
	8501	4	3250	100	156	100
Grand mean	Mean improved	24	3477	116	107.1	61
	Mean local (8501)	12	2993	100	177	100
Mean variety	ADV	12	3747	125	95	54
	K9351	12	3206	107	119	67
	8501	12	2993	100	177	100

GHANA

INTRODUCTION

Striga spp. cause serious economic losses to cereal crops such as millet, sorghum and maize. Although not unknown in Ghana in times past, the increasing spread and severity of striga infestation in Ghana is thought to be associated with the increasing cultivation of maize and the migration of livestock to Ghana from neighbouring countries through their faeces which are known spread striga as some ingested seeds retain their viability after passing through the intestinal tract of ruminants. The objectives of the trials in Ghana were to promote the growing of striga tolerant varieties and to execute an integrated control strategy for striga control in striga-endemic locations in northern Ghana.

In 2007, the locations of demonstration trials were moved from the northeastern part of Ghana, where considerable impact had been generated, to the northwestern part, a new area. This strategy was aimed at extending the coverage of the area that would benefit from the various striga control technologies.

The activities planned included:

1. Demonstration of STR varieties and other technologies including rotation and intercropping on-farm.
2. Evaluation of converted lines on-station.
3. Outreach program: rural radio broadcast/field day.
4. Capacity building of Agric Extension Agents.
5. Seed production and Community seed production.

All the activities were implemented to various extents with the exception of outreach program involving rural radio broadcasts and field days. Although the demonstrations carried out focused mainly on intercropping and rotation trials, seeds of STR varieties were also packaged for distribution to farmers for assessment against drought. Drought in the savanna increases geometrically the losses due to striga. The numbers of farmers involved in these activities are provided in the **Table 12** below.

Table 12. Number of farmers that participated in demonstrations in Ghana

System	Expected number	Actual number
Intercropping	40	20
Rotation	40	20
Drought	14	14
Total	94	54

Methodology

Two cropping systems (rotation and intercropping maize with soybean) were demonstrated on-farm to control striga infestation. For the intercropping, four plots were demarcated. Two of the plots were intercropped with soybean while the other two were sole. The striga-tolerant varieties used were ACR 97 TZL Comp 1-W (which is well-adapted to the southern Guinea savanna zone of Ghana) and IWD STR. Each farmer had only one of the two varieties, so the two plots under soybean intercropping consisted of one STR variety and the farmers' variety. The pair-row system was adopted (i.e. two rows of soybean following two rows of maize). All the participating farmers were male. As is always the case, MOFA staff (extension agents) assisted in the farmers for the project. All the demonstrations were on family land, with some of the fields degraded and previously abandoned because they could not support a cereal crop. For the rotation participants, three 20 m x 20 m plots were demarcated. One of the plots was planted to the farmer's variety, the second to an improved striga tolerant/ resistant variety (STR), and the third planted with soybean. In 2008, STR maize would be planted to the plot to which soybean was planted in 2007 and vice-versa. The third plot planted with the farmers' variety would be

Table 13. Performance of farmers' maize and STR maize varieties under intercropping with soybean in northern Ghana.

Treatment	Striga count 12 WAP no. ha^{-1}	Maize grain yield kg ha^{-1}	Soybean grain yield kg ha^{-1}
Farmer's variety planted sole	2000	650	-
STR variety planted sole	960	1000	-
Farmers' variety intercropped	1500	300	1000
STR variety intercropped	730	400	1100

Table 14. Maize grain yield and striga count in the first year of cereal-legume rotation

Treatment	Striga count 12 WAP no. ha^{-1}	Maize grain yield kg ha^{-1}
Farmers' variety	1920	350
STR maize	775	550

planted to the same variety year-in, year-out. Fertilizer was provided and followed local recommendations. Weeding was done as required. The following data were collected:

1. Plant stand after thinning.
2. Plant stand at harvest.
3. Striga count at 10 and 12 weeks after sowing.
4. Striga score at 10 and 12 weeks after sowing.
5. Total number of ears.
6. Weight of ears harvested.
7. Grain weight of harvested ears.
8. Soybean grain yield.

The 2007 Growing Season in Northern Ghana

The year 2007 was not favorable to maize farmers in Northern Ghana. The very early rains deceived farmers to plant. Soon after planting, there was no rain for over 40 days and when it started raining again it was nearly on daily basis about the milking stage of maize. Thereafter, no rain fell again. Due to the erratic rainfall during the season, only half of the demonstrations were established, and these were planted during the last week of July and first week of August 2007. Given the lateness of the planting, growing seedlings were destroyed by rodents and birds, resulting in very poor plant stand for both the maize and soybeans. The poor plant stand, in turn, led to poor grain yields.

RESULTS

Intercropping Trials

Grain yield of the farmers' maize under sole cropping was 650 kg ha^{-1} and under intercropping was 300 kg ha^{-1} (**Table 13**). Thus, yield reduction as a result of intercropping was about 54%. The density of striga plants was higher in the sole than in the intercropping. The average grain yield of the striga-tolerant varieties was higher than that produced by the farmers' variety (**Table 13**). The STR varieties also supported less emerged striga plants compared to those supported by the farmers' variety.

Rotation Trials

Despite the poor conditions under which the trials were carried out, the superiority of the STR varieties was also evident under rotation. This was manifested by slightly higher grain yield and a reduction by more than half of the emerged striga plants (**Table 14**).

Evaluation of converted varieties for striga tolerance

STR varieties converted from normal endosperm to QPM were evaluated on-station. Due to poor conditions prevalent during the cropping season, the plot was flooded and had low stand with only few emerged striga plants. For meaningful results, the evaluation will be carried out in 2008.

Capacity building of Stakeholders

Data collection as well and the nature of striga infestation have been major constraints in the execution of the demonstrations. Therefore, the agricultural extension agents of the Ministry of Food and Agriculture, the participating farmers, students and teachers were given a one day training on field layout, data collection and recording, striga biology and control methods. The distribution of participants is presented in **Table 15**.

Table 15. One day training course participation

Discipline	Number
AEAs of MoFA	10
Participating farmers	40
Students and teachers	20

Seed production

Seeds of ACR 97 TZL Comp 1 W, IWD STR C1 and GH120DYDF pop was produced to meet some of the seed requirement of the project. The bulk-sibbing method was used, and 40 kg seed of each of the varieties listed above was produced♦

NIGERIA

Moist Savanna (Coordinated by the University of Agriculture, Abeokuta)

INTRODUCTION

During the wet season of 2007, both on-farm demonstration of *Striga* Management Technology involving rotation of non-host crops which started in 2006 and diffusion of *Striga*- tolerant maize varieties were carried out in the moist savanna agroecological zones of Nigeria.

On-farm Demonstration of Rotation of Non-hosts for *Striga* Management in Maize

Many farmers have indicated preference for sole crop of maize and groundnut rather than intercrop as a means of reducing *Striga* problem through trap cropping. They attributed the preference to the fact that monoculture would reduce interspecific competition and allow crops to express their full potentials as well as reduce vertebrate pest problem, especially in the wetter savanna.

Groundnut var. RMP 91 has been identified and used as an effective trap-crop for *Striga* management in maize. Being a versatile food crop commonly grown in the *Striga* endemic areas of the country, its adoption as a rotational crop will not create a serious problem. When intercropped or planted in rotation, it has been consistently observed to effectively reduce *Striga* infestation and incidence on maize, which in turn translated to lower damage on maize. Following the government's effort to promote the production of cassava both as source of calories in human diet and income through sale for export and industrial use, attempts were made to incorporate the crop in the rotational system for *Striga* management. This has been made possible by the existence of short-season low moisture-requiring varieties which would grow during the dry season and be ready for harvest just before the commencement of the wet season. Being a non-host, the cassava cultivation would also prevent the infestation of the farm by many grasses which could have served as alternative hosts to *Striga* hermonthica and allowed its production of seeds for increased infestation.

In 2006, three plots were established on each of the twenty and fifteen farms at Mokwa and Bida, respectively to commence the demonstration of the *Striga* Management Technologies. Each plot had either STR maize var. TZL Syn Comp. 1-Y, groundnut var. RMP 91 or farmer's maize varieties. The improved STR maize variety was subjected to the recommended production practices (viz spacing and fertilizer application) while the farmer's varieties were also produced using the farmer's practices. Groundnut was at 25cm intra row spacing on 75cm wide inter rows. At harvest, the produce from the three plots were weighed for yields while the groundnut plots were properly cleaned and prepared for cassava which was planted immediately afterwards. The cassava was harvested in June, 2007. This plot and that which had improved STR maize in 2006 were planted with the STR maize while the plot with the farmers' practice in 2006 had the farmers' varieties repeated on it in 2007. The production practices on these plots were in accordance with those of 2006.

Results

The results obtained in the demonstrations indicated that technical and socio-economic benefits were derived from the inclusion of rotation of groundnut and cassava with STR maize for *Striga* management in maize production. The technical result on the performance of *Striga* management technologies in maize production on farmers' fields at Mokwa and Bida are contained in Tables 16 to 19. In 2006, the improved STR Maize had significantly higher cob number and cob and grain yields at both locations compared with the farmers' varieties (**Table 16**). In the second year (2007), the plots with improved STR maize had significantly lower *Striga* shoot counts, lower

Table 16. Cob and grain yields of maize on Striga-infested farmers' fields at Mokwa and Bida in 2006 wet season.

	Total number of cobs no./ha	Cob yield kg/ha	Grain yield kg/ha
Mokwa			
Improved STR maize	47930 a	2500 a	1543 a
Farmers' practice	33800 b	1733 b	1003 b
SE±	3860.0	216.0	85.67
Bida			
Improved STR maize	50700 a	2930 a	1770 a
Farmers' practice	43300 b	2304 b	1540 b
SE	4012.0	187.2	49.3

incidence and number of flowering shoots and lower crop reaction score of maize to *Striga* parasitism compared with the farmers' varieties. The improved STR maize which followed groundnut and cassava rotation however exhibited significantly lower reaction to *Striga* than the one that followed the same variety planted in the previous year (**Tables 17 & 18**).

Maize stand and plant count, crop vigour score, cob number and yield, shelling percentage and grain yield were significantly higher on the plots with the improved STR maize compared with farmers' practice at both locations. Furthermore, vigour score and cob yield at both locations and grain yield at Mokwa of STR maize which followed non-host crop rotations were however higher than that of the respective STR maize which followed the same maize variety in the previous year (**Tables 18 & 19**). It is apparent that improved STR maize performed better than the farmers' varieties under *Striga* infestation at both locations as earlier observed and reported. However replacement of STR maize in the first year with a good trap crop variety, groundnut variety RMP91, further enhanced the growth and cob yield of STR maize in 2007 at both locations and even grain yield at Mokwa which is known to have more virulent *Striga* biotype.

These results confirm the need to integrate two or more methods for effective *Striga* management especially at locations where virulence of the parasite has been adjudged high. In this report, the component of the *Striga* Management Technology reported herein are trap crop of groundnut variety RMP 91, control of alternate striga hosts (grasses) through the planting of cassava, planting of STR maize, application of adequate fertilizer and hoe-weeding to remove weeds including *Striga*.

Table 20 contains results on the economics of trap crop rotation for *Striga* management in maize on farmers' fields at Mokwa and Bida. The table contains information on the total cost of crop production, total crop value, gross margin and return to financial investment in 2006 and 2007. The values of the crops in 2006 were lower at Mokwa than at Bida. The values of the STR maize and groundnut harvests in 2006 were about twice that of the farmers' practice at Mokwa and higher by N11,000 and N7000 respectively at Bida. The total crop value, gross margin and return to naira invested at the end of the second year 2007 were higher at Bida than Mokwa, possibly due to higher virulence of *Striga* at the latter location. Although the grain yields of maize that followed groundnut and cassava

Table 17. Effect of trap crop rotation on Striga shoot count, incidence and fruiting on maize in the Nigerian moist savanna, 2007 wet season

	Striga Shoot Count/ha 15WAP	Striga Incidence/ha 15WAP	Number of Flowering /Fruiting Striga/ha
Bida			
Improved STR maize alone	237.8 b	114.2 b	71.3 b
Rotation with Groundnut/Cassava			
Before Improved variety	156.8 b	80.9 b	28.6 b
Farmers' Variety (Practice)	999.0 a	552.8 a	304.4 a
SE	103.56	57.61	36.96
Mokwa			
Improved STR maize alone	346.0 b	237.6 b	137.7 b
Rotation with Groundnut/Cassava			
Before Improved Variety	196.0 b	129.3 b	54.3 b
Farmers' Variety (Practice)	1641.5 a	1208.2 a	583.3 a
SE	168.32	122.32	52.00

Table 18. Effect of trap crop rotation on maize plant and stand count, crop vigour and reaction scores in the Nigerian moist savanna, 2007 wet season

	Maize Stand Count/ha 15WAP	Maize Plant Count/ha 15WAP	Maize Vigour Score 10WAP	Maize Reaction Score 10WAP
Bida				
Improved STR maize alone	27130 a	54133 a	3.7 b	3.3 b
Rotation with Groundnut/ Cassava before the Improved STR maize	27203 a	54302 a	4.3 a	2.7 b
Farmers' Variety (Practice)	26678 b	53090 b	3.1 c	4.6 a
SE	56.61	135.33	0.17	0.22
Mokwa				
Improved STR maize alone	27164 a	54128 a	3.8 b	3.8 b
Rotation with Groundnut/ Cassava before the Improved STR maize	27131 a	54161 a	4.8 a	2.4 b
Farmers' Variety (Practice)	26641 b	53328 b	2.5 c	5.3 a
SE	84.33	103.32	0.21	0.28

Table 19. Effect of trap crop on maize cob and grain yields in the Nigerian moist savanna, 2007 wet season

	No. of Maize Cobs/ha	Cob Yield kg/ha	Grain Yield kg/ha	Shelling Percentage
Bida				
Improved STR maize alone	52823 a	3628 b	2809 a	75.0 a
Rotation with Groundnut/ Cassava before the Improved STR maize	53876 a	4250 a	3272 a	77.4 a
Farmers' Variety (Practice)	40453 b	2924 c	599 b	44.7 b
SE	2840.8	147.3	400.5	7.35
Mokwa				
Improved STR maize alone	50387 a	3439 b	2299 b	75.0 a
Rotation with Groundnut/ Cassava before the Improved STR maize	53674 a	4317 a	3286 a	77.4 a
Farmers' Variety (Practice)	39604 b	1070 c	1097 c	44.7 b
SE	1584.5	289.0	195.0	7.35

Table 20 **Performance of STR maize varieties on some *Striga* infested farms at Mokwa, Bida and Shonga in the Nigerian moist savanna, 2007 wet season.**

	Maize Stand Count 15 WAP	Striga Shoot Count 15 WAP	Total Number of Cobs 15 WAP	Cob yield kg/ha	Grain yield kg/ha
Mokwa					
Improved STR maize	25408	433.3b	48775a	4012a	3068a
Farmers' practice	24067	2158.3a	29817b	2097b	1409b
SE ±	459.0	262.6	3085.6	245.0	221.7
Bida					
Improved STR maize	26050	425.0b	49700a	3159a	2395a
Farmers' practice	24888	1425.0a	36013b	2318b	1571b
SE ±	614.0	169.96	2366.3	155.8	131.6
Shonga					
Improved STR maize	26760	180b	51900a	3792a	3186a
Farmers' practice	26420	800a	38100b	2870b	2302b
SE ±	56.5	2567.3	234.3	212.7	

rotation were higher than those of the other two technologies at both locations, the values of cassava were 36.7 and 36.4% of the total crop values in this demonstration at Bida and Mokwa, respectively. The high cassava values further boosted total crop value in the rotation technology. Gross margins were N138,950, N272,085 and N16950 for consecutive improved STR maize cultivation, non-host crop rotation and farmers' practice, respectively at Bida and N101, 550, N251,825 and N11,600 at Mokwa. Similarly, return to invested naira for consecutive STR maize rotation before STR maize cultivation and farmers' practice were N1.54, N2.17 and N0.23 respectively at Bida and N1.18, N2.03 and N0.15 at Mokwa.

It should be noted that the additional values of groundnut haulm and cassava cuttings were not included in the total crop values given for rotation technology. It is therefore apparent that planting groundnut as trap crop in rotation during the wet season, followed by cassava during the off-season before an STR maize variety in the following season, would be technically feasible, economically viable and sustainable for the management of *Striga* in maize production in the Southern Guinea Savanna agroecological zone.

Diffusion of STR maize varieties

Seeds of *Striga* tolerant maize varieties were distributed to a total of 201 farmers who had serious *Striga* infestation at various locations in the moist savanna of Nigeria. The details of the distribution are shown in **Table 21**. Many of the farmers were assisted to purchase fertilizer on request while others purchased theirs from the agro-service centre and traders in the market. The farmers were advised to plant the crop close to the farm planted with their local varieties. They were regularly reminded of maize production practices. At the locations, 25% of the farmers given seeds had their plots monitored for the performance of the varieties with respect to *Striga* emergence, maize stand and plant counts as well as cob and grain yields (**Table 21**).

The improved STR maize supported significantly lower *Striga* shoot count and

produced higher grain yield of maize compared with the farmers' varieties at the three locations. Average maize grain yields at Mokwa, Bida and Shonga were 3.1 t ha^{-1}, 2.4 t ha^{-1} and 3.2 t ha^{-1} respectively for the improved STR variety and 1.4 t ha^{-1}, 1.6 t ha^{-1} and 2.3 t ha^{-1}, respectively, for the farmers' varieties.

It is apparent that the new STR synthetic maize variety combined tolerance with effective reduction of *Striga* infestation at the three locations. Reduction of maize grain yield was also higher at Mokwa than at the two other locations which had lower *Striga* infestation.

Economics of Striga management using STR maize

The farmers' practice had the lowest gross margin and lowest return to investment. Although total production cost was highest with rotation of STR maize, groundnut and cassava, it also had the highest return on investment to justify the technology (**Table 22**)•

Table 21. Distribution of STR Maize Seeds to Farmers for Planting on *Striga* Infested Fields in the Moist Savanna of Nigeria in 2006 wet season.

Location	Ecological Zone	Number of Farmers Given seeds	Number of Farmers Monitored
Imeko	Forest-Savanna Transition	50[1]	1.2
Odo-erin	Forest-Savanna Transition	11[1]	5
Eruwa	Forest-Savanna Transition	15[1]	10
Shonga	Derived Savanna	25[2]	5
Mokwa	Southern Guinea Savanna	60[2]	12
Bida	Southern Guinea Savanna	40[2]	8
Total		**201**	**52**

Table 22. **Economics of Rotation for Striga Management in Maize on Farmers' Plots at Mokwa and Bida**

	2006 Crop		2006/2007 Crop		2007 Crop		Total production			
	Yield (kg/ha)	Value (%)	Yield (kg/ha)	Value (%)	Yield (kg/ha)	Value (%)	Total Crop (Value)	Cost (%)	Gross Margin (%)	Return to Naira (%)
Bida										
Improved STR maize	1770[1]	88,500	-	-	2809	140,450	228,950	90,000	138,950	1.54
Rotation	3367[2]	84,175	14,981[3]	14,810	3272	163,600	397,585	125,500	272,085	2.17
Farmer's practice	1540[1]	77,000	-	-	299	14,950	91,350	75,500	16,950	0.23
Bida										
Improved STR maize	1452	72,600	-	-	2299	114,950	187,550	86000	101,550	1.18
Rotation	2989	74,725	13,673	13,800	3286	164,300	375,825	124,000	251,825	2.03
Farmer's practice	735	36,750	-	-	1097	54,850	91,600	80,000	11,600	0.15

1 Maize Grain
2 Groundnut pod
3 Fresh tuber of cassava

Southern Guinea and Sudan Savanna

(Coordinated by Ahmadu Bello University, Zaria)

INTRODUCTION

The northern Guinea and Sudan savannas are arguably the most striga-infested ecological zone in Nigeria and other West and Central Africa countries. It is therefore expected that the damage caused by striga would be more in these ecological zones. The overall goal of the project in these ecological zones is the cultivation and profitable management of striga-infested field, which are usually abandoned by farmers, through the use of legume trap crops in a rotation system with striga-tolerant maize varieties. The legume in the system helps to improve soil fertility through symbiotic nitrogen fixation while at the same time reduces the striga soil seed bank, translating into immediate and long-term benefits to farmers. Under the project reported herein, a number of activities were carried out, major among which are:

(i) demonstration trials involving legume rotation with STR maize varieties.

(ii) evaluation of early and extra-early striga-tolerant maize varieties for striga control in the Sudan savanna.

(iii) the production of seeds of striga-tolerant maize varieties and legume trap-crops to facilitate the implementation of subsequent years' trials and for diffusion to generate maximum impact.

A total of 27 on-farm demonstrations were carried out in the ecological zones indicated. Also, production of seeds of the crop varieties being used in the project was carried out on-station on 1.3 ha.

Demonstration of Legume-Maize Rotation for Striga Control

The 27 on-farm demonstrations were carried out in three locations viz.Gwarzo in the Sudan savanna, and Dutse-Gaiya and Mallaum in the Southern Guinea savanna. Previous trials were carried out in the northern Guinea savanna. The need to increase the coverage area of the project necessitated the movement of the trials to the Sudan and Southern Guinea savanna. The maize variety Across 97 TZL Comp1-W was planted in rotation with either soybean or cowpea as the legume. The variety of soybean used was TGX 1448-2E and cowpea CV IT93K 452-1. There were three plots on each farmer's field. Plot size was 20 m x 20 m, with maize and cowpea planted at recommended spacings. Other cultural practices viz. thinning, fertilizer application, weeding (not inclusive of striga), and insecticide application in cowpea were as recommended. One field in each of the three locations was set aside as the Farmers' Field School (FFS) site where all the operations were first demonstrated to the farmers before implementation on their farms. Regular visits were made to the fields. Data collected include number of emerged striga shoots, host damage on a scale of 1 to 9 as is the practice, plant and ear heights as well as yield components of maize and seed yield of the legumes.

Considerable variation was observed in grain yield among the locations, but grain yield of ACR 97 TZL Comp 5-W- the STR variety was higher than mean yield of the farmers' varieties by 71% in Dutse-Gaiya, 107% in Gwarzo and 262% in Mallagum. Striga plants on the farmers' varieties were significantly higher in the two locations where striga count data were collected (**Table 23**). Cowpea was used in the rotation only at Gwarzo and its mean yield was 0.99 t ha^{-1}. Mean legume yield was highest with soybean at Mallagum (1.65 t ha^{-1}) (**Table 24**).

Socio –Economic Analysis of the Improved *Striga* Management Interventions in the Sudan and Southern Guinea Savanna Zones of Nigeria.

The variable cost components considered in the analysis are listed in **Tables 25** and **26**. The difference in the total variable cost of production between the *Striga* tolerant maize variety and

Table 23. Crop performance in Gwarzo (Sudan savanna), Dutse-Gaiya (southern Guinea) and Mallagum (southern Guinea) in 2007

Variety	Plant Height (cm)	Ear height (cm)	Striga count/ha 9 WAP	Crop damage 9WAP	Striga count/ha at harv.	Crop damage at har.	Cob weight kg/ha	Grain yield kg/ha
Gwarzo								
ACR 97 TZE Comp5-W	152.0 b	91.0 b	-	-	23 b	-	-	3108 b
Farmers' Variety	168.0 a	95.0 a	-	-	43 a	-	-	2895 b
SE	0.02	0.77	-	-	1.69	-	-	23.3
Dutse-Gaiya								
ACR 97 TZE Comp5-W	196.0 b	24.2 b	126.4 b	-	170 b	-	1088 a	895 a
Farmers' Variety	181.0 a	19.9 a	151.6 a	-	211 a	-	683 b	523 b
SE	0.05	0.30	3.95	-	5.0	-	67.5	62.3
Mallagum								
ACR 97TZE Comp5-W	189 b	-	-	-	-	-	-	2375 a
Farmers' Variety	154 a	-	-	-	-	-	-	905 b
SE	0.07	-	-	-	-	-	-	98.0

farmers' varieties was attributable to the differences in costs of seeds, bags (sacks) and transportation in the two agro-ecological zones. The costs and returns analysis in the Tables show that labour and fertilizers inputs accounted for greater parts of the total variable costs incurred in both varieties. Labour cost, relative to the total cost of production was 42.7 and 46.1% for the *Striga* tole-rant maize variety and farmers' varieties at Dutse –Gaiya in SGS and 43.5 and 46 6% at Mallagum (SGS), while in Gwarzo in the Sudan savanna respective values were 63.2 and 64.1%.

The farm gate price of maize (N 60/kg) was used in estimating the revenue and comparing with the total variable costs to obtain the gross margin which measured the economic performance of the two maize varieties. The gross margin analysis of the two agro-ecological zones (SGS and SS) shows that it is profitable to cultivate *Striga* tolerant maize variety than farmer's variety. These results indicate that intensification and expansion of production of *Striga* tolerant maize variety will reduce and or control *Striga* menace in the zone.

Table 24 . Grain yield of legumes in three locations in northern Nigeria in 2005 wet season before maize planting in 2007

Location	Legume crop	Average yield (kg/ha)
Gwarzo	Cowpea cv. IT93K 452-1	986
Dutse-Gaiya	Soybean cv. TGX1448-2E	522
Mallagum	Soybean cv. TGX1448-2E	1652

In terms of gross margin per Naira invested, in SGS, for every one Naira invested on the *Striga* tolerant maize variety and farmer's variety, a net gain of 40 kobo and loss of −17 kobo was obtained at Dutse-Gaiya, and N2.29 kobo and 34 kobo at Mallagum (SGS). In SS, the gross margin per Naira invested indicates that for every one Naira invested on *Striga* tolerant maize variety and farmer's variety, N1.86 and N1.68 were the net gains. The result indicates that *Striga* tolerant maize variety generated more returns to farmers than farmer's variety. Therefore, farmers should be encouraged to invest their resources in the improved *Striga* tolerant variety.

Table 25. Cost and return analysis in Gwarzo (Sudan savanna) Nigeria 2007

	Acr.97 TZL Comp. 1-W		Farmers' Variety	
	Cost (N/ha)	Percentage	Cost (N/ha)	Percentage
1.Costs:				
Seed	2000.00	3.00	1600.00	2.25
Fertilizers	18625.00	28.531	8625.00	28.93
Bags (sacks)	1860	2.85	1740.00	2.70
Labour:				
Land preparation/Ridging	8333.33	12.76	8333.33	12.94
Planting	3333.33	5.11	3333.33	5.18
Fertilizer application	7500.00	11.49	7500.00	11.65
Weeding	10000.00	15.32	10000.00	15.53
Earthing-up	5833.33	8.94	5833.33	9.06
Harvesting	4166.67	6.38	4166.67	6.47
Threshing	2083.33	3.20	2083.33	3.24
Transportation	1550.00	2.37	1450.00	2.25
Total Variable Cost (TVC)	65,284.99		64,384.99	
2.Returns:				
Average yield (kg/ha)	3108		2875	
Average price (N/kg)	60.00		60.00	
Gross revenue (N/ha)	186,480.00		172,500.00	
Gross margin (GR-TVC) (N/ha)	121,195.01		108,115.01	

Farmers' perception of the *Striga* tolerant and Farmers'maize varieties.

In the two agro-ecological zones, farmers' perception of the *Striga*-tolerant maize variety and farmers' varieties was assessed in terms of crop germination, crop growth, crop maturity, grain/cob filling, grain size, yield, *Striga* emergence and crop damage/symptoms. According to the farmers themselves, their varieties showed poor germination, slow growth rate, late maturity, poor grain filling, moderate grain size, very poor yield, high *Striga* emergence and crop damage severity. However, the improved *Striga* tolerant variety had better characteristics and performed very well under *Striga* infestation. Farmers in the two agro-ecological zones requested for more seeds of the improved maize variety for the next season's production. Thus, there is need to encourage seed multiplication of the *Striga* tolerant maize variety at farmers' level. This will enable more farmers to benefit from the technology; which invariably will lead to wide adoption of the technology to control *Striga* menace in these agro-ecological zones.

Impact assessment of adoption of Striga control technologies in locations where the project has been executed since 2002.

In Tashan Dolle in the Sudan savanna, 60% of the farmers (lead farmers) have adopted sole planting of improved *Striga* tolerant maize variety in controlling the Striga menace in their farms, while 30% adopted improved *Striga* tolerant maize variety in rotation with soybean and 10% have adopted improved *Striga* tolerant maize variety in rotation with cowpea. Since the introduction of technologies to the lead farmers in 2002, 1130 farmers (Secondary farmers) have requested and collected seeds from the lead farmers and trying the technologies. In terms of yield, the farmers reported that there has been a general improvement in the yield of maize and income generated from maize production for the past 4 years. There is high demand for seeds of *Striga* tolerant maize varieties and trap crops both within and outside their communities. Thus,

Table 26. Cost and return analysis of striga control technologies

Costs/Returns Items	LOCATION A. Dutse Gaiya (SGS)				LOCATION B. Mallagum (SGS)			
	ACR.97TZL Comp.1-W	%	Farmers Variety	%	ACR.97TZE Comp.1-W	%	Farmer's Variety	%
(1) COSTS								
Seed	2000.00	5.21	1600.00	4.25	2000.00	4.9	1600.00	3.96
Fertilizer	18625.00	48.55	18625.00	49.52	18625.00	53.63	18625.00	46.07
Bag (Sacks)	900.00	2.35	600	1.60	2400.00	6.27	900.00	2.23
Labor								
Land Preparation	2197.92	5.73	2197.92	5.84	4027.75	5.99	4027.75	9.96
Planting	1770.83	4.62	1770.83	4.71	1770.83	2.39	1770.83	4.38
Fertilizer Application	3229.17	8.42	322917	8.59	2777.83		2777.83	6.87
Weeding	3646.25	9.51	3646.25	9.69	2187.50		2187.50	5.41
Earthening Up	1666.67	4.34	1666.67	4.43	4062.50		4062.50	10.05
Harvesting	2135.42	5.57	2135.42	5.68	1840.25		1840.25	4.55
Threshing	1739.53	4.53	1739.53	4.63	2187.50		2187.50	5.41
Transportation	450.00	1.12	300.00	0.80	1450.00		450.00	1.11
Total Variable Cost (TVC)	**N38360.79**		**37610.79**		**N43,329.16**		**N40429.16**	
(2) RETURNS								
Average yield (kg/ha)	895		522		2375		905	
Average Price (kg/ha)	60.00		60		60.00		60.00	
Gross Revenue (N/ha)	N53700.00		31320.00		142,500.00		54300.00	
Gross Margin (GR-TVC)	N15339.21		-N6290.00		N99,170.84		N13,870.84	
Gross Margin/N/ha	0.40		-0.17		2.29		0.34	

there is the need for more seed dissemination and scaling up of the technologies to new locations in 2008 project year.

In the northern Guinea savanna (Tashan Ice and Tashan Tsamiya), 60% of the farmers (lead farmers) have adopted improved *Striga* tolerant maize variety in rotation with soybean, while 40% have adopted sole planting of improved *Striga* tolerant maize variety in controlling *Striga*. Since the introduction of technologies to the lead farmers in 2002, 165 farmers (Secondary farmers) have requested and collected seeds from the lead farmers. The farmers also reported that there is high demand for seed of *Striga* tolerant maize varieties and trap crops both within and outside their communities.

Three locations were used for impact assessment in the southern Guinea savanna viz. Allo, Zano Kataf and Agnwal-Jaba. In Allo, 70% of the farmers (lead farmers) have adopted improved *Striga* tolerant maize variety in rotation with soybean, while 30% have adopted sole planting of improved *Striga* tolerant maize variety. An estimated 285 additional farmers have requested and collected seeds from those who participated in the project. In Zango Kataf, 80% of the farmers who took part in the project have adopted improved *Striga* tolerant maize variety in rotation with soybean, while 20% have adopted sole planting of improved *Striga* tolerant maize variety. A total of 122 additional farmers have requested and collected seeds from the lead farmers. In Angwal-Jaba, 90% of the participating farmers have adopted improved *Striga*-tolerant maize varieties in rotation with soybean, while 10% have adopted sole planting of improved *Striga* tolerant maize variety. In this location the lead farmers had disseminated seed to 124 farmers.

In general, the impact analysis shows that there has been a great reduction in Striga menace and improvement in crop yield and income of the lead farmers that participated in the project. Thus, there is need for intensification and expansion of the Striga tolerant maize varieties and legume trap crops in these agro-ecological zones•

BENIN

INTRODUCTION

The objective of the project in Benin was to promote integrated striga control measures for maize production at the level of the farmer. It is doubtful if this objective can be achieved without giving consideration to other cereal crops such as sorghum. Sorghum is by far the most infested crop by striga due to the fact that its cultivation is not supported by a rotation system with leguminous crops like maize. Heavy striga infestation on sorghum permits abundant striga seed production which could be lethal to a subsequent crop of maize. For this reason, farmers' field schools were created in 2005 and 2006 to address the problem of both maize and sorghum with striga. In 2007, the project aimed at using this method to control *Striga hermonthica* using maize variety ACR 94 TZE Comp5-W and cowpea cultivar TVX 1850 - 01F in farmers' field using the farmers' field school strategy promoted in 2005 and 2006.

Methodology

New villages were identified in Pehunco division. These included Tissirou 1 and Tissirou 2 as well as Kika where farmers reported heavy striga infestation. The farmers' field schools created at Kika consisted of 19 women and 2 men. Three plots were used for field activities and these consisted of one plot for Jupiter soybean, one plot having Across 94 TZL Comp 5-W and one plot for the farmer's maize variety, suspected to be DMR-ESR-W which has been contaminated over time. Farmers' field school on sorghum consisted of two established treatments viz. direct seeding and transplanting. For soybean, Tissorou 1 was used and Jupiter variety of soybean was compared to the local variety.

In addition to the newly established farmers' fields, farmers' field schools established in 2005 and 2006 were visited to assess the level of diffusion of Across 94 TZE Comp 5-W and cowpea variety TVX 1850-01F. Soybean variety Jupiter was introduced to provide an option for the cowpea variety being used as a trap crop.

Results and Discussion

Complete grain yield data were not yet available as at the time this report was being compiled. However, it was observed that in spite of the late planting, participating farmers were satisfied with the technologies demonstrated viz. Across 94 TZE Comp 5-W and with the soybean variety Jupiter. The limited data available at the time of writing this report indicated a yield of 1.0 t ha^{-1} for the STR maize variety and 0.8 t ha^{-1} for soybean variety Jupiter. The local maize variety planted one month earlier produced a mean grain yield of 1.5 t ha^{-1}. *Striga hermonthica* infestation was poor, partly due to the late planting. Sorghum grain yields of 0.7 and 0.8 t ha^{-1} were obtained for the direct seeding and transplanting treatments, respectively. Very little effect was observed for the transplanting treatment. It is likely that Mr. Zime, a former farmers' field school participant may obtain up to 2.0 t ha^{-1} of maize grain from his field, an estimate based on the observation of visiting Dr. Charles The.

Replenishment of seeds has been a big problem for the project. The maize seeds showed heavy signs of contamination as evidenced by the different seed color of the kernels. Obtaining the seeds of TVX-1850-01 is also a problem since farmers consume or sometimes sell all their harvested seeds.

CONCLUSION AND SUGGESTION

In spite of the late planting, Across 94 TZE Comp 5-W exhibited good performance and was appreciated, especially by farmers at Kika. The same is true for soybean Jupiter. A major problem is the availability of seed of the maize variety being demonstrated. In addition, there is a need for a facilitator to conduct the farmers' field school activities, otherwise the only activity that would be possible in the zone will be the seed distribution and monitoring of the diffusion•

MALI

INTRODUCTION

Maize is used mainly as a food crop in Mali. It has become the main crop for food security and sustainability. Maize production constraints in Mali comprise of poor soil fertility, high cost of input and *Striga hermonthica*. Other related constraints include the high cost of inputs, lack of market and lack of improved cultivars, especially hybrids, adapted to the different ecological zones. To solve these problems, the Mali Maize Programme, in collaboration with SAFGRAD, has been conducting trials aimed at testing tolerant varieties in rotation with leguminous crops. The Korean government-AU/SAFGRAD project for striga control is in line with IER programme objective of improving farming systems to increase maize production.

Between 1990 and 1999, maize production in Mali increase by 13.6% compared to 2.0% and 1.8% for millet and sorghum, respectively. During this period, maize production followed the quantity and distribution of rainfall. The two major objectives of the striga control project in Mali were to (i) demonstrate on-farm, the superior performance of two maize varieties Across 94 TZL Comp 5-W and EVDT97 STRC1 for striga control, and (ii) make available to farmers appropriate cultural techniques for striga control.

Methodology

In 2007, four villages located in CMDT and OHVN zones were used to demonstrate and disseminate striga control technologies to 24 farmers. The trial comprised four maize varieties viz. Across 94 TZL Comp 5-%, EVST 97 STRC1, Dembanyuman and the farmers' variety as the check. Plot size was 10 m x 10 m. Maize spacing was 0.80 m x 0.50 m. Three seeds were planted and thinned to two plants per hill to achieve a population of 50,000 plants per hectare. At planting 100 kg per hectare of NPK and 50 kg per hectare of urea were applied. The second dose of fertilizer consisted of 100 kg per hectare of urea. Data were collected on plant stand after germination, plant stand after thinning, plant stand at harvest, number of ears harvested and grain yield. Data taken on striga include number of striga plants per square meter at 60, 75 and 90 days after planting.

Results

The 2007 cropping season was characterized by lateness of the rains, which after commencement did not stop for one month. *Striga hermonthica* infestation was generally very low. Results obtained indicated the superiority of Across 94 TZL Comp 5-W, EVDT STRC1 and Dembanyuman in controlling *Striga hermonthica* over the local check, i.e. farmers' varieties. Further analysis of the planting environments revealed three groups for the environments on-farm. About 80% of the observed variability for grain yield could be explained for by two production situations in relation to farmers' ability. In the first group were farmers which produced less than 2 t ha^{-1}. The second group consisted of farmers that produced over 4 t ha^{-1} of grain with the third group being intermediate.

CONCLUSION

There is the need to complement the usual analysis of variance with the analysis of environments, especially given the fact that there were no significant differences among the three improved varieties for grain yield. The environment adaptability study showed poor and good environments as well as one that is intermediate◆

BURKINA FASO

INTRODUCTION

In 2007, activities were conducted in collaboration with farmer organizations whose farms were affected by striga. The intensification of maize cultivation faces new challenges which usually necessitate the use of newly opened lands. One of such challenges is poor soil fertility, which is associated with the striga problem. The 2007 cropping season was characterized by the late establishment of the rains (mid-july) and by its sudden stoppage in September. These conditions constrained good grain yield.

The objectives of the project in Burkina Faso were to (i) identify among available maize germplasm, high yielding varieties which are tolerant or resistant to striga as well as identify cowpea and soybean varieties with potential for use in striga management and control, (ii) improve maize cultivars and existing cropping system in order to improve tolerance and resistance as well as existing cropping systems against striga, (iii) evaluate and disseminate maize varieties as well as cultural practices with potential for improving grain yield in striga-infested areas, (iv) produce and sustain seed production of tolerant maize varieties, and (v) train farmers on the use of appropriate integrated cultural practices against striga.

Activities and Major Results

Improvement of elite varieties tolerant of striga

The conversion of elite varieties already in use by farmers (Espoir, Obatanpa) was done and the variability in the materials explored. S_1 families were created from the two varieties. These families were evaluated for their tolerance to drought. The selected families will be evaluated in 2008 for their tolerance to striga using artificial striga infestation.

Introduction and evaluation of striga-tolerant varieties in striga-infested areas

New maize varieties were introduced and evaluated under natural striga infestation in Lena and using artificial striga infestation in Farako Ba. In Lena, Across 94 TZE Comp 5-W and Acr 94 TZE Comp 5-Y were evaluated by 50 participating farmers in spite of the drought experienced in the area. Four maize varieties namely TZEE W Pop STR QPM, TZEEY Pop STR QPM, TZE Y Pop STR QPM and TZEW Pop DT STR QPM were introduced WECAMAN and evaluated at Farako Ba Station, Vallee du Kou and Wempea. The results are presented in **Table 27**. TZEE-Y Pop STR QPM and TZEE-Y Pop STR QPM gave good yields of 3.15 and 5.13 t ha^{-1} in striga-free plots at Farako Ba in spite of planting at the end of July and in spite of rainfall problems. However, In Wempea – a striga-infested area and with the poor rainfall, these materials performed poorly. These results reinforce earlier published reports that the simultaneous occurrence of striga and drought can be much more devastating that either of the two stress. It was observed that the white-seeded materials were still segregating for protein content.

Table 27. **On-station performance of four introduced varieties in Burkina Faso**

Variety	Grain yield (t/ha)
TZEE W Pop STR QPM	3.15
TZEE Y Pop STR QPM	5.03
TZE Y Pop STR QPM	1.36
TZE W Pop DT STR QPM	1.02

Technology transfer and training of farmers

Activities conducted in this regard included (i) varietal demonstration trials and (ii) demonstration of agronomic practices with potential to combat striga

Varietal demonstration

This type of trial involved the comparison of two STR varieties namely Across 94 TZE Comp5-Y and Across 94 TZE Comp 5-W with the farmers' varieties. Results obtained at 15 sites mainly in the Sissili area on 100 m^2 plots are presented in **Table 28**. The trials conducted in Lena and Wempea was severely affected by drought and could not be harvested. The level of striga infestation varied from one village to another. No striga infestation was observed at Zoro. Low infestation was observed at few sites while infestation was moderate at most of the testing sites. Two STR varieties had striga plant per maize plant values of 2.0 and 2.1 (where 0 = no striga, 1 = an average

Table 28. **Grain yield and Striga abundance score in demonstration trials in Burkina Faso, 2007**

Name of farmer	Location	Planting date	Variety	Grain yield (kg/ha)	Striga per maize plant
Konate, B.	Koubounga	03/08/07	SR21	600	2
			Comp5-Y	800	3
Kondombo, S.	Goum	28/08/07	Comp5-Y	1500	2
			Espoir	1900	2
Nignan, B.	Napar	23/08/07	Comp5-W	800	2
			WARI	1200	2
Kondombo, S.	Leo	27/07/07	SR21	1500	2
			Comp5-Y	1900	2
Sawadogo, K	Kayerobo	25/07/07	SR22	600	3
			Comp5-W	1700	3
Nignan, S.	Leo	24/07/07	Comp5-Y	800	1
			KEB	700	0
Boukougou, I.	Nablaliassou	29/07/07	Wari	1000	2
			Comp5-W	200	2
Yaldia, K.	Hiela	01/08/07	SR21	300	1
			Comp5-W	500	3
Some, P.	Bozo	04/08/07	SR22	250	3
			Comp5-W	500	3
Somda, P.	Bozo	01/08/07	Comp5-W	300	3
			KEB	500	1
Dahourou, J.	Bouyaque	05/08/07	Comp5-Y	400	3
			WARI	350	2
Zongo, P	Nalon	14/08/07	SR21	150	2
			Comp5-W	450	2
Sienou, B.	To	12/08/07	Comp5-W	515	2
			Wari	300	2

Planting was not carried out on two farms; Striga abundance score, 0 = no incidence, 1,2, and 3 = 1, 2, and 3 striga plants per maize plant of one striga plant per maize plant, 2 = an average of 2 striga plants per maize plant, and 3 = an average of 3 striga plants per maize plant). Grain yield obtained varied from 150 kg ha^{-1} to 1900 kg ha^{-1}. These yields were related to rainfall and striga damage. The best cultivars were Across 94 TZE Comp 5-Y, Across 94 TZE Comp 5-W and Wari.

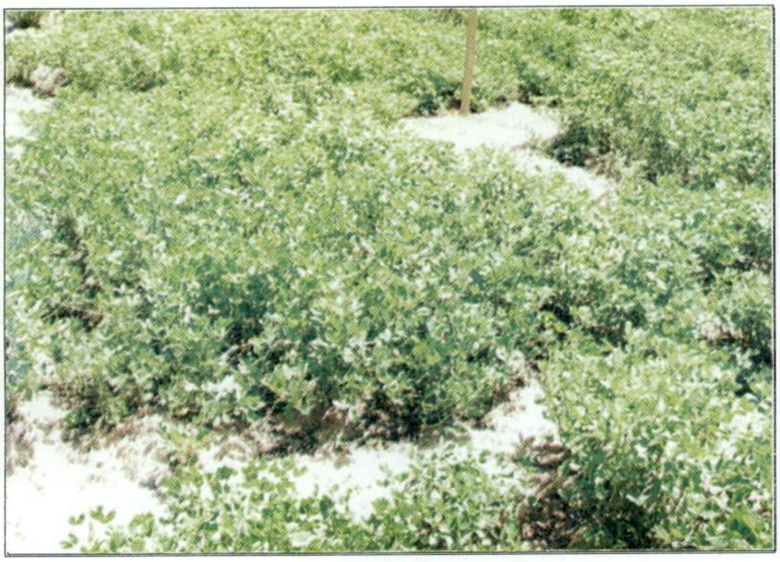
Agronomic practices to control striga

In each of the locations used, the demonstrated trials were used as farmers' field school where good agronomic practices against *Striga hermonthica* were discussed with the participating farmers. The trials consisted of three plots each of 1000 m^2. Each farm will be used for three years to demonstrate the use of crop rotation with legumes to control striga. All the test sites had striga with the number varying from 350 to 27710 plants per hectare. Grain yield obtained was very low, a result attributable to the drought and striga infestation. It was also observed that the susceptible varieties KPB and KEB supported the highest number of striga plants (**Table 29**). As expected all the plots with trap crops did not have striga plants, an observation made by the participating farmers, given that cowpea and soybean are not parasitized by *Striga hermonthica* but stimulate it to germinate. The striga-tolerant varieties exhibited lower striga infestation and had maize grain yield ranging from 580 to 638 kg ha^{-1}. Soybean variety G196 was heavily destroyed by livestock and this contributed to its low yield.

In the eastern part of Burkina Faso, four farmers' fields were implemented and these were at Kouare and at Komin Yaago. These trials were implemented in Striga-infested zones and each had three plots; one plot had STR maize (which was either Across 94 TZE Comp5-W or Across 94 TZE Comp 5-Y), the second plot had the farmers' variety (Espoir)

Table 29. Yield of maize and legumes in rotation trials in western Burkina Faso in 2007

Farmer	Site	Crop	Variety	No. of Striga per hectare	Grain yield (kg/ha)
Groupement Ala ka Femignin	Wempea	Maize	Comp5-W	590	180
		Maize	Local	2000	50
		Cowpea	KVX 396	0	10
Coulibaly, A	Adama	Maize	Comp5-Y	715	100
		Maize	Local	3750	49
		Soybean	G196	0	18
Millogo, Julien	Lena	Maize	Comp5W	1110	580
		Maize	KEJ	2820	320
		Cowpea	KVX 396	0	200
Millogo, D.	Lena	Maize	Comp5-Y	4220	850
		Maize	KPB	27710	250
		Cowpea	KVX 396	0	90
Millogo, A.	Lena	Maize	Comp5-Y	3502	950
		Maize	SR21	3858	450
		Soybean	G196	0	80
Millogo, Joachim	Lena	Maize	Comp5-Y	350	650
		Maize	Local	1170	270
		Cowpea	KVX 396	0	150
Millogo, E.	Lena	Maize	Comp5-1	715	80
		Maize	SR21	820	600
		Cowpea	KVX 396	0	160



while the third plot was planted to a leguminous trap crop which was either cowpea (KVX61-1 or KVX 396-4-5-2D) or soybean (G196). The trials were conducted in two locations which experienced drought. Few emerged striga plants were observed and maize could not be harvested due to poor performance as a result of drought.

Seed Production of STR Maize

Two activities were carried out namely the multiplication of seeds of STR maize varieties and the multiplication of seeds of leguminous trap crops. In the western part of Burkina Faso, seed multiplication was done on 1 ha of land by two farmers in Lena and one farmer in Wempea. These farmers underwent the training course on certified seed production. Millogo Die Julien and Coulibaly Mamadou obtained 725 kg of seed of ACR 94 TZE Comp 5-Y and Millogo Mesmin had 600 kg of ACR 94 TZE Comp 5-W. The 1375 Kg of seed sold at CFA 500 per kg gave an income CFA 600,000.

Seed production of soybean variety G196 was done by two farmers, one located in Lena, and the other one in Wempea on 0.5 ha of land. In Lena, only 85 kg was obtained due to drought. In eastern Burkina Faso, cowpea seed multiplication was carried out by four farmers at two locations. The cowpea varieties were KVX 61-1 and KVX 396-4-5-2D. Seeds produced for these two varieties were 152 kg and 203 kg, respectively. The training course on seed multiplication was attended by 16 farmers in Kouare and 12 farmers in Comin-yaaga.

CONCLUSION

The 2007 cropping season was a very difficult one. The late planting of the trials due to the lateness of the rains resulted in low yields. However, most of the planned activities were conducted♦

V. CONCLUSIONS AND RECOMMANDATIONS

A number of activities were carried out in 2007 under African Striga Control Project funded by the government of the Republic of Korea and African Union. These activities included on-farm variety demonstration trials, on-farm rotation trials involving maize-cowpea/soybean/ groundnut as well as intercropping of maize with any of the afore-mentioned legumes, multiplication of seeds of STR maize varieties and legume crop varieties used for trap cropping in the two crop production systems on station, community seed production, training of farmers and extension agents and diffusion of technology implemented by distributing 2-3 kg packed seeds to farmers in striga-infested areas. The latter activity integrates farmers as key players in providing solution to the problem that confronts them and is likely to facilitate sustainability of the striga control technologies when the project is over.

The various activities were executed with varying levels of success in the participating countries namely Benin, Ghana, Cameroon, Nigeria, Burkina Faso and Mali. Although Cote d'Ivoire implemented the project in past years and even attended the Review and Planning workshop for 2007, the political situation in the country did not permit the execution of the project in the year under reporting. Equally present at the Review and Planning Workshop were scientists from Niger, Sudan, Ethiopia and Zambia, all of who expressed the desire of their countries to join the regional initiative to combat striga in the sub-region. These countries were welcome to join the project but for reasons of logistics and shortness of time could not carry out any activity in 2007.

Drought was a major constraint in 2007, especially in Ghana, Burkina Faso and Mali and adversely affected the yields of various crops, not only on farmlands associated with the project but throughout many locations in these countries.

The involvement of breeders in the execution of the project in countries where these specialists are not yet involved is recommended, especially in Benin. This will ensure that good quality and adequate seeds are available for various activities being carried out in the project, particularly the diffusion of the STR technology. Particular attention need to be devoted to community seed production in countries where this is not yet integrated.

Although the number of participating farmers increased in 2007 compared to 2005 season (2755 vs 2073), the number of farmers involved in demonstration trials was actually lower in 2007. Only one country (Ghana) conducted intercropping trials. Data obtained from Ghana, Benin and Mali were scanty for meaningful deductions and were not in line with the recommendations made during the Review and Planning Workshop.

Release of funds for execution of the project was very early in 2007, a factor that contributed to the involvement of more farmers. This is commendable. Monitoring tours were carried out to Benin, Ghana, Burkina Faso and Mali. Logistics for monitoring the tour were major problems in Benin and Ghana. The passing away of Dr. Ibrahim Kureh made impossible the monitoring tour to northern Nigeria.

It was a very challenging exercise producing the 2007 Annual Report for this project. The problems were many, and included inconsistent reporting format from country to country, notwithstanding that formats have been suggested for each of the types of trials being executed under the project, the noninclusion of relevant data and very scanty reports by some countries, lack of units of reported data in some instances, and errors in values presented in tables. The expectation had been that with time the quality of reporting by national programmes would improve but this has not been the case for many countries. In many instances, the consultants had to retype tables because of the inappropriateness of the layout and because space bar were used instead of 'tab'. Addressing these issues in subsequent years would make the job of the consultant in terms of producing the annual report less stressful*

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Cameroon	Institut de la Recherche Agricole pour le Développement IRAD, Yaoundé	***Dr. Charles The***
Côte d'Ivoire	Centre National de Recherche Agronomique, Abidjan	***Dr. Louise Akanvou***
Ghana	Savanna Agricultural Research Institute Nyankpala, Tamale, Ghana	***Dr. M. Abdulai***
Mali	Centre Régional de Recherche Agronomique de Sotuba. Institut d'Economie Rurale, Ministère de l'Agriculture, de l'Elevage et de la Pêche, République du Mali	***Mr. N. Coulibaly***
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