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Collaborative Striga Research and Control Program in Africa

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Collaborative Striga Research and Control Program in Africa

Executive Summary

Through a Collaborative Striga Research and Control Project funded by the Government of the Republic of South Korea and the Organization of African Unity, *Striga hermonthica* control trials were conducted in several countries of Western, Central, Eastern and Southern Africa in 1999. The report summarizes results obtained in Western and Central Africa.

To develop and promote appropriate integrated striga control technologies and ensure effective transfer of these technologies to farmers, a total of 136 on-farm adaptive trials and demonstrations were implemented in Benin, Côte d'Ivoire, Ghana, Nigeria and Cameroon. Through the trials, several promising maize varieties were identified to be further evaluated or released. In Cote d'Ivoire for example, Across 94 TZE Comp 5-W, Across TZE Comp 5-Y and IWD STR had better grain yield and less striga emergence than farmers' varieties. In Benin and Ghana, striga emergence was low, but, the trend observed is encouraging as to the effectiveness of STR maize varieties in striga control.

Economic analysis of the technologies also revealed that the improved technologies would yield higher net return under farmers' traditional mixed cropping system than local varieties.

In general, farmers tend to rate the new varieties higher than their local ones, because of their perceived advantages, in terms of higher yields, striga reduction and other attributes.

1. Introduction

Striga hermonthica, a parasitic weed, attacks cereal and leguminous crops throughout Sub-Saharan Africa (SSA), particularly in highly populated semi-arid regions. Crop yield losses from 30 to 40% and some time total crop failures due to striga infestations have been reported. Attainment of food security in the region is dependent upon the development and implementation of effective control of striga.

Progress achieved by individual sub-Saharan African countries in striga control have been slow and non significant. This have been probably due to:

- the weak complementary and synergy among NARES, IARCs and other institutions engaged in striga research and control.
- the fact that no single country in sub-Saharan Africa has the scientific capacities and resources to effectively control striga infestation.
- the 'non participation' of farmers with multidisciplinary research teams engaged in improving agricultural production and productivity.

In the few cases where various integrated technology packages for striga control have been developed, the precarious condition of food production systems (poor soil fertility, low input) makes difficult the adoption of such technologies.

The Africa Striga Collaborative Research and Control Program, funded by the Government of the Republic of South Korea and the Organization of African Unity was a response to increasing striga problem. Aiming at enhancing complementarity and synergy for an effective striga control, the program is implemented through partnership with participating NARS, farmers, IARI (South Korea), IITA, CIMMYT, ICRISAT, the West and Central Africa Maize Network (WECAMAN) and the National Agricultural Extension Systems.

The purposes of the collaborative programme were :

- To enhance partnership, complementary and synergy among stakeholders including farmers, extension agency, NGOs, NAREs, IARCs and other private institutions engaged in striga research and control.
- To establish a striga consultative group here called Striga Task Force (STF).
- To enhance on-farm adaptative evaluation of integrated striga control technology packages in focal countries in S.S.A.

- To serve as a forum of exchange of technical information as well as to articulate policy issues and to build awareness from community to government levels to facilitate support for striga research and control.

- To articulate the link between striga control and food security

The objectives of the on-farm striga demonstration trials, set at a task force meeting held on 4-5 March 1999 in Abidjan, were as follows:

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

The following report synthesizes the progress made by participating countries in West and Central Africa towards the attainment of the set objectives during the period 1 January 1999 to 31 December 1999.

2 Coordination activities undertaken

2.1 Striga task force

Before launching the program, it was deemed appropriate to submit program strategy and mode of operation to the appreciation of a group of specialists in striga research and control in the region. The striga task force (STF) meeting which took place 4-5 March 1999 in Abidjan, Côte d'Ivoire, was attended by a dozen of NARS scientific directors and scientists working at different capacity on striga. The following summarizes the conclusions and recommendations of this forum.

- Based on the economic importance of maize, and the capacity and comparative advantages to undertake striga research, focal countries were identified and recommended by the STF for their participation in the striga control project. They include Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Nigeria, Mali and Togo in west and central Africa. In east and southern Africa, focal countries for on-farm testing and demonstration include Kenya and Tanzania; variety evaluation will be undertaken in Ethiopia, Malawi, Uganda and Zimbabwe.

- To ensure flexibility and to enable the participating countries to choose technologies compatible with their respective cropping systems, four models of on-farm adaptive striga control trials were proposed. Each model includes a control treatment, i.e., the farmer's current production technologies, viz. cultivars and agronomic practices. The plot size for each treatment should be 25 x 25 m.

The models are as follows :

Model-1. A three years rotation consisting of three treatments rotated each year: (1) farmer's practices; (2) Striga tolerant improved maize cultivar with NPK fertilizers; (3) Striga improved maize cultivar intercropped with a N-fixing legume trap crop.

Model-2. Continuous cultivation of a striga tolerant maize cultivar intercropped with a N-fixing legume trap crop tested against farmer's practices.

Model-3. A three years rotation with treatments rotated each year: (1) a N-fixing legume trap crop, (2) a cotton crop, and (3) a striga tolerant improved maize cultivar.

Model-4. A two years rotation with two treatments rotated each year: (1) a striga tolerant improved maize cultivar, and (2) a cotton crop. The farmer's practices will be observed from a nearby field.

2.2 Monitoring of on-farm demonstration trial activities

During the first task force meeting, seed availability to participating NARS and timely funds dispatching were identified as crucial to a successful implementation of the program. Initial monitoring activities confirmed that seed unavailability was a major problem, resulting in bottleneck for the execution of trials. IITA in collaboration with the maize network worked with the coordination to facilitate dispatching of seed and also ensure that such problem will be avoided the following years.

A monitoring tour of field activities was undertaken by the Coordination, in collaboration with WECAMAN and IITA, from 13 September to 11 October 1999. The team was composed of Drs. Charles The (IRAD, Cameroon, Program Coordinator), Victor Adetimirin (then at IARI, South Korea), Mahama Ouedraogo (SAFGRAD), Badu B-Apraku (WECAMAN Coordinator), and Jennifer Kling (IITA, Ibadan). Due to time and financial constraints, only Benin, Cameroon and

Côte d'Ivoire benefited of this monitoring visit. The following recommendations were made based on findings of the monitoring tour:

- Funds for the 1999 trials were received timely in all participating countries, it is then recommended that the same system be used to channel funds for the year 2000 trials.
- Seeds for the trials arrived late in most countries, leading to a late establishment of the trials except in Nigeria; There is a need for early start of seed procurement for year 2000 trials. The Program Coordinator, who is a breeder and has adequate irrigation facilities in his country program, could be given the responsibility of producing and distributing seed.
- In some countries, trials were carried out in an ecology with more than 1300 mm rainfall per annum. Yet varieties planted were early and extra-early. It is recommended that appropriate STR variety of intermediate maturity cycle be used in such areas.
- Considering that the amount and timing of fertilizer application were very much a problem in some countries, extension agents and research teams should work together to ensure that all agronomic practices needed are properly done.
- Legumes used in some countries has not been tested as striga trap crop. Given the fact that Benin and IITA have tested and classified many legume varieties as good striga trap crops, it is recommended that STR maize varieties be used along with proven leguminous trap crop for all maize/legume inter-cropping trials. Moreover, participating NARS should as much as possible take advantage of IITA and WECAMAN facilities and STR materials. The density of the legume crop should also be optimized for improved trap cropping efficiency, and yet avoid competition with the main crop, which is maize.
- Villages and trials sites should be carefully chosen as to represent the striga situation in the country. It is then recommended to avoid planting trials too close to each other and in addition selected villages should be evenly distributed within striga infested areas.
- To enhance technology transfer and participation of farmers, it is recommended that farmer's field day be organized for all successful trials.

3 Achievements of country level programs

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

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

3.1 Ghana

Two models (models 2 and 3) of on-farm demonstration trials were implemented based on the dominant cropping system of the community with emphasis on the reduction of the seed bank of striga in the soil so as to reduce the infestation level below the economic threshold.

Maize/Legume Inter-cropped

In Tingoli, Kpalaga and Cheshegu in the Tolon/Kumbungu administrative district where the dominant cropping system is continuous cropping of mixed crops on the same piece of land, nine farmers evaluated the continuous cropping of a mixed crop of striga tolerant maize varieties intercropped with a N fixing trap crop (soybean). Four treatment made up of two striga tolerant maize varieties (STREC-WI, TZL Comp 1 C_4), a striga susceptible maize variety (Dorke SR) were inter-cropped with a N fixing trap crop (soybean variety salintuya 5). The above treatments were tested against farmers practices. Plot size varied from 100 m^2 to 280 m^2.

Crop Rotation

In the Walewale district, crop rotation trials involving eight farmers were implemented. These trials were made of two treatments:

a) The continuous cultivation of striga trap crops and striga tolerant maize varieties and b) farmer's practices. The sequence of the rotation for the 3 years duration was soybean (first year) followed by cotton (second year) and then a striga tolerant maize variety (third year). Plot sizes were 25 m x 25 m.

Results obtained in Ghana for both type of trials showed that :

- Striga emergence was not only poor on both experimental and farmers' fields throughout northern Ghana, but was generally very erratic and variable. The number of emerged striga plant ha^{-1} did not vary significantly ($P<0.05$) among maize varieties. However, the striga susceptible variety Dorke SR had higher striga plant population (3,326) than IWD STR Co (1,385) and Across 92 TZE Comp 5 W (408) (Table 1). Unusual high and continuous rainfall could partially account for the low emergence of striga plants.
- There was no statistical ($P<0.05$) differences in grain yield among the different maize varieties. Dorke-SR had the highest grain yield of 1.78 tons ha^{-1} which represented 16% grain superiority over IWD STR Co (1.53 ton ha^{-1}) and Across 92 TZE Comp 5 W (1.54 tons ha^{-1})
- Soybean grain yield was not influenced by the different maize varieties.

Table 1: Striga population, plant biomass and grain yield as influence by maize varieties

	Population at harvest/ha	**Plant biomass at harvest (tons/ha)**		**Grain yield (tons/ha)**	
Maize Varieties	**striga**	**Maize**	**Soybean**	**Maize**	**Soybean**
IWD STR CO	1 385	1.87	1.67	1.53	0.650
ACR 92 TZE Comp5	408	1.72	1.65	1.54	0.609
Dorke-SR	3 326	2.13	1.60	1.78	0.735
LSD	**ns**	**ns**	**ns**	**ns**	**ns**
CV (%)	**61.96**	**20.57**	**22.78**	**30.02**	**34.68**

ns=(P>0.05) ***=P<0.01* ****=P<0.001*

3.2 Côte d'Ivoire

Activities were implemented in the localities of Ferkessedougou and Nielle, in northern Côte d'Ivoire where striga is endemic, causing farmers to abandon highly infested fields.

Variety Trial

Four striga tolerant maize varieties and a local check were compared at eight farmers fields known to have high occurrence of striga. Varieties used were EVDT 97 STR, Across 94 TZE Comp 5-W, Across 94 TZE Comp 5-Y and IWD STR Co. Each trial consisted of 4 row plots of 10 m long.

Analysis of variance computed on 6 trials showed no significant differences among tested varieties. In Ferkessedougou, IWD STR Co which was the best STR maize yielded 4% lower than the local check. In Nielle, Across 94 TZE Comp 5-W yielded 3014 kg ha^{-1}, which represented a 10% yield increase over the local check. Across 94 TZE Comp 5-W and Across TZE Comp 5-Y exhibited less striga symptoms and less striga plants emerged as compared to the local check. Higher grain yields observed for the local checks were partially due to their longer maturity cycle.

Maize/Legume
In this second experimentation, four treatments (sole STR maize variety, sole cowpea, STR maize variety intercropped with cowpea, and farmers practice) were compared in 900 m2 plots. The second year, there will be a rotation between the STR maize variety and the cowpea treatments. Eight such trials were implemented in areas of Ferkessedougou and Nielle. Results obtained in 6 trials revealed no significant maize grain yield differences between striga tolerant maize (Acr94 TZE Comp5-W) sole as compared to striga tolerant maize inter-cropped with cowpea. Farmer practice consisting of local maize sole had more striga plants emerged.

3.3 Benin

In Benin Trials were implanted in the localities of Zakpota (Central Benin) and Ouake in the north. In both regions, striga infestation is common and causes important crop losses.

Fifteen trials consisting of a tolerant striga variety, Across 92 TZE Comp.5 W and a local maize called "jaune de Za" evaluated as sole crop and inter-cropped with cowpea or groundnut, were implemented in Zakpota. In this zone, an average 1 striga plant per m^2 were observed in all trials. STR maize yielded the same as local maize (664 kg ha^{-1}) whether inter-cropped or as sole crop. This low yield was partially attributed to low fertilization applied on very degraded land. Cowpea yield when inter-cropped with maize varied from 90.0 kg ha^{-1} to 166 kg ha^{-1}. Groundnut yield when intercropped with maize varied from 670 kg ha^{-1} to 121.3 kg ha^{-1}.

In the locality of Ouake, Across 92 TZE Comp.5-W in sole and inter-cropped with cowpea were compared with farmer variety inter-cropped with cowpea in 20 on-farm trials. *Striga hermonthica* infestation was observed in about half of the trials. In general 0.5 striga plant per m2 were obtained in this zone, which was considered very low. On infested field, sole Across 92 TZE Comp.5-W yielded 1721.5 kg ha^{-1} as compared to 1525.1 kg ha-1 when inter-cropped with leguminous crop. These yields were statistically superior to local maize yield (DMRESR) of 1272.3 kg ha^{-1}

In non infested fields, grain yields for Across 92 TZE Comp.5-W were 1679 and 1649 kg/ha respectively in sole and inter-cropped with legume. Grain yield in farmer practice was 1297.6 kg/ha.

Maize yields obtained in non-infested fields were not statistically different from those obtained in infested fields. This was due to the low infestation observed.

Cowpea varietal effect was also noticed in the results. Cowpea yield at Ouake varied from 27.0 kg ha^{-1} to 100.0 kg ha^{-1} for "Yankalo" and from 104 to 218 kg/ha for "youpi-youpi". On average the performance of cowpea variety "youpi-youpi" was better than Yankolo" both as sole and in association with maize. However, cowpea varietal effect of striga emergence was not apparent. Maize inter-cropped with the cowpea variety "Yankolo" produced generally lower grain yield (1333.1 kg ha$^{-1)}$ as compared to inter-cropping with the cowpea variety "youpi-youpi" (1691.3 kg ha$^{-1)}$.

3.4 Cameroon

Striga research activities in Cameroon were conducted in three ecological zones:
Sub-humid in the localities of Tchollire, Ngong and Garoua
Transition in the locality of Guider
Semi-arid in the localities of Maroua and Guidiguis
In all these localities, both maize variety trials and maize/cowpea inter-cropping trials were conducted.

Variety Trial

Six variety trials consisting of 4 treatments each were conducted in 6 different farmers' fields. Entries consisted of 2 single crosses (Oba Super 1 and 87036 x 88094), one three way crosses (ObaSuper 1 x Exp$_3$7), two yellow intermediate (110 days) striga tolerant composite (STR yellow, Cam Inb. STR $_1$), one white intermediate striga tolerant composite (Advanced NCRE) and one white synthetic (Syn E1). All these entries were divided in 3 sets. Each set was evaluated in 2 villages. Each trial consisted of 4 varieties (3 striga tolerant and the local check CMS 8501). Experimental plot was a 13 row plot $^{-1}$, 24 m long . Set 1 consisting of 86036 x 88094, Oba Super 1, STR-yellow and CMS 8501, were tested at Ngong and Sanguere Paul sites, all of which were infested with *Striga hermonthica;* the trials revealed no significant grain yield differences among the striga tolerant entries. However, Oba Super 1 (2484 kg ha^{-1}) showed a slight yield advantage over the two other STR maize. STR varieties yielded at least 7% more than the local check. Only Oba Super 1 out yielded the local check by 23%.

Set 2 consisting of Advanced NCRE STR, Oba Super 1, STR yellow and CMS 8501 (local check) were evaluated at Tcholiré and Guidiguis. These two sites had low striga infestation. No significant grain yield differences were observed among the 4 varieties. However Oba Super 1

(1901 kg ha^{-1}) and Advanced NCRE STR (1823 kg ha –1) exhibited respectively a 10% and 6% yield superiority over the local check, CMS 8501.

Set 3 consisting of Syn E1, Cam Inb. STR 1, Cam. Inb. STR, Oba Super 1 x $Exp_3 7$, and CMS 8501 were tested in Sudan Savanna area (Guider and MORA). Significant yield differences were obtained between striga tolerant varieties and the local check. Oba Super 1 x $Exp_3 7$ (2836 kg ha^{-1}) out yielded the other entries and showed 56% yield superiority over the check. Syn E1 (2363 kg ha^{-1}) and Cam Inb STR 1 (2365kg ha-1) also exhibited 30% yield superiority over the local check.

In partial conclusion for variety trial in Cameroon , it was observed that striga tolerant varieties generally out yielded the local check under heavy striga infestation. The grain yield superiority was 56%, 30%, 30% and 23% for Oba Super 1 x Exp $_3 7$, Sy E1, Cam. Inb. STR_1, and Oba Super 1 respectively.

Maize/Cowpea Association Trials

Treatments for this trials consisted of :

- Tolerant maize alone
- N. Fixing legume alone (cowpea)
- Tolerant maize and N. fixing legume inter-cropped.
- Farmer practice (local maize sole).

Ten trials were conducted. Striga tolerant maize varieties used varied from one farmer to the other and consisted of advanced NCRE STR for those farmers who preferred white maize and of Cam Inb STR 1 or STR yellow for those farmers who preferred yellow maize. The experimental plots consisted of a 13 rows $plot^{-1}$ of 24 m.

Highly significantly differences ($p<0.01$) were detected among sites/farmers. The best treatment was striga tolerant maize in association with cowpea. The treatment yielded an average of 2513 kg ha^{-1} ; This represented 25% yield increase over the farmer practice. The treatment also exhibited the highest plant stand ear number at harvest and the lowest striga plant emerged per maize plant (0.7). Even though no significant grain yield difference was observed, number of plants and ears at harvest differences were observed between STR maize alone and the local check. The tolerant maize had significantly lower striga plant emerged per maize plant.

3.5 Nigeria

A total of 52 farmers conducted the maize/legume inter-cropped trials in Nigeria. These demonstration trial consisted of inter-cropping an improved horizontally striga resistant maize hybrid (Oba Super 1) or (9022-13), an improved horizontally resistant open pollinated maize variety (Across 92 TZE Comp 5-W, IWD STR Co or TZL Comp 1 C4) with an improved Alectra tolerant groundnut (RMP 91) or soybean (Samsoy2). These technologies were compared with farmers local maize varieties planted sole. Plot size was 150 m^2.

At each site, a farmer's field was set aside as the farmers' field school (FFS) where all the operations were first demonstrated to the farmers before their implementation on their farms. The operations which farmers were trained to do correctly initially in the field included: land preparation, thinning, weeding, and fertilizer application.

At maize tasselling, a field day attended by other researchers, extensionists as well as participating and non-participating farmers in the community was conducted. This facilitated further interaction among farmers to enhance on the spot assessment of all the farms. Farmers were allowed to ask questions based on their observations and answers were provided to their questions.

Guinea Savanna

At Bida, both striga infestation (shoot count) and incidence (crop plants infested) were significantly higher on farmers plots compared with those of improved technologies of inter-crop of Oba Super 1 or TZL Comp 1 C4 with Groundnut. Oba Super 1 (4827 kg ha^{-1}) and TZL Comp 1 C_4 (3592 kg ha^{-1}) significantly out yielded the farmer practices by 91% and 42%, respectively; the two varieties also showed fewer striga plants, better crop vigor score and higher cob number per hectare as compared to farmer's local maize.

At Beji-Minna, plots with Oba Super 1 and IWD STR Co exhibited lower striga infestation, less striga symptoms (crop reaction) and more than 29% grain yield superiority as compared to the local maize variety.

At Gwagwalada in Abuja, no grain yield difference was observed between the two improved maize varieties (9022-13 and TZL Comp. 1 C_4). However, these two varieties yielded at least 235% better than the local check and they exhibited better striga syndrome reaction .

Northern Guinea Savanna

Nineteen farmers conducted this trial in that zone. At Detu when groundnut variety RMP 91 was used as leguminous crop, in spite of the similar striga incidence and infestation observed on the plots, 9022-13 exhibited lower striga symptoms and produced significantly more cobs and 42% grain yield superiority over the farmers' practice. IWD STR Co had only 10% yield advantage over the farmers' practices.

When at Detu, soybean Samsoy 2 was used as leguminous crop, yield increased of Oba super 1 and TZL Comp. C4 was 6% and 15% superior to the farmer practice, respectively. Striga infestation at this site was also low.

At Sakaru, 9022-13 and IWD STR Co had a non significant lower striga infestation and incidence but significant lower striga syndrome, higher crop vigor and produced 17% and 26% more grain yield than the farmers varieties.

Sudan Savanna

Ten trials were conducted in that zone. At Yandoto-Daji, treatments did not have significant effect on all the striga crop parameters even though slightly lower cob and grain yield were produced by farmers varieties as compared to the improved Oba super 1 and TZL Comp 1 C_4.

The performance of the improved Striga tolerant maize varieties varied with the level of infestation, soil type and the ecotype of Striga. This emphasizes the need for location specific demonstrations. There is also a need to improve agronomic practices to ensure maximum benefit from the trap-crop and enhanced tolerance by the host crop.

Cost and Returns Analysis of Technologies

Economics analysis of the new striga control technologies was determined for the demonstration conducted at Detu and Sakaru in Northern Guinea Savanna and Yandoto – Daji in Sudan Savanna. The various costs components were monitored from the inception of farming activities through harvest, crop processing to bagging. The differences in the cost of production between the hybrid, open-pollinated and farmers' varieties was only attributable to the cost of seeds, since all other input cost components were used at the same level. Using the farm gate price, the net revenue obtained for maize, groundnut and soybean are reported for the four localities in tables 2-5.

The results from these three locations have shown clearly that under good management practices inter-crop of appropriate legume trap crops would enhance profitable cultivation of maize on Striga infested fields. It equally shows that the improved technologies would perform better under the farmers' traditional mixed cropping system than their local varieties as evidenced by the highest net return of the hybrids and STR maize variety compared to the farmer variety.

Farmers' Perception and Acceptance of Striga Management Technologies
These parameters were determined by administration of questionnaire and through informal discussion during visits and on open day.

The result showing the degree of acceptance of striga management technologies are as presented in Table 6. The criteria considered in the perception rating included maize type, Striga reduction, crop appearance, cob yield, grain filling and seed colour. Among the five varieties demonstrated, the ratings followed the order Oba Super I > 9022-13 > TZL Comp. 1 C4 > IWD STR CO > farmers' varieties. The exercise has revealed that farmers will prefer these new technologies to their local ones because of their perceived advantages, in terms of higher yields, striga reduction and other attributes, over the local maize varieties.

Table 2: Costs and returns performance of horizontally resistant maize varieties inter-cropped with soybean on Striga infested farmers' field at Detu Nigeria, 1999 wet season.[1]

Item	Oba Super1 + Samsoy2	Farmers Local Maize (sole)	TZL Compl.C4 + Samsoy2
Total cost of production (₦)[1]	38450.00	33330.00	37710.00
Total crop value/Gross Revenue(₦)	59060.00	38410.00	63460.00
Net Revenue/Profit(₦)	20610.00	5080.00	25750.00
Profit/(₦) Invested	0.54	0.15	0.68

Table 3: Costs and returns performance of horizontally resistant maize varieties inter-cropped with groundnut on Striga infested farmers' fields at Sakaru, Nigeria, 1999 wet season.

Item	Oba Super1 + RMP 91	Farmers Local Maize (sole)	TZL Compl.C4 + RMP91
Total cost of production (₦)	36400.00	33330.00	35430.00
Total crop value/Gross Revenue(₦)	37825.00	26450.00	38710.00
Net Revenue/Profit(₦)	1425.00	-6880.00	3280.00
Profit/(₦) Invested	0.04	-0.21	0.10

[1] Costs and returns are expressed in naira; 1 US dollar equals approximatively 110 ₦

Table 4: Costs and returns performance of horizontally resistant maize varieties inter-cropped with soybean on striga infested farmers' fields at Yandoto Daji, Nigeria, 1999 wet season.

Item	Oba Super1 + Samsoy2	Farmers Local Maize (sole)	TZL Compl.C4 + Samsoy 2
Total cost of production (₦)	37950.00	33330.00	37210.00
Total crop value/Gross Revenue(₦)	75500.00	23830.00	76990.00
Net Revenue/Profit(₦)	37550.00	-9500.00	39780.00
Profit/(₦) Invested	0.99	0.29	1.07

Table 5: Costs and returns performance of horizontally resistant maize varieties inter-cropped with groundnut on striga infested farmers' fields at Yandoto Daji, Nigeria, 1999 wet season.

Item	Oba Super1 + RMP91	Farmers Local Maize (sole)	TZL Compl.C4 + RMP91
Total cost of production (₦)	36370.00	33330.00	35630.00
Total crop value/Gross Revenue (₦)	33890.00	23830.00	33985.00
Net Revenue/Profit (₦)	-2480.00	-9500.00	-1645.00
Profit/(₦) Invested	-0.07	-0.29	-0.05

Table 6: Farmer's perception of striga control technologies at Detu, Sakaru and Yandoto – Daji in Nigeria, 1999 wet season.

	Maize Type*	Striga Reduction* at		Crop Appearance*		Cob Yield*	Grain filling*	Seed Colour*	Favorable Impression*
		12WAS	Harvest	9WAS	12WAS				
Oba super 1	3.60	3.60	3.60	3.60	3.60	3.60	3.80	3.60	4.00
9022-13 STR	3.91	3.55	3.18	3.36	3.36	3.82	3.73	3.64	4.00
IWD STR CO	3.09	3.18	3.18	3.45	3.45	3.45	3.55	3.36	4.00
TZL Comp IC4	3.30	3.60	3.60	3.60	3.60	3.40	3.10	3.50	4.00
Farmer's Variety	2.38	2.48	2.48	2.29	2.29	2.52	2.38	2.43	3.95

* Excellent = 4; Good = 3; Fair = 2; Poor/Bad = 1.

4 Conclusions and recommendations

In all focal countries, striga tolerant maize varieties generally out-yielded the local maize . In Benin, Côte d'Ivoire and Cameroon, variety trials allowed identification of new striga tolerant maize varieties for release. However, greater progress would have been achieved if the appropriate technologies were tested in adequate zones i.e the use of intermediate maturing varieties (110 days) in areas with more than 1000 mm of rainfall in Benin and Côte d'Ivoire . The identification and dissemination of striga tolerant varieties by itself could permit 20-30% grain maize production increase in tested countries.

Maize/legume inter-cropped trial as well as rotation trial revealed:

- No yield losses between treatment consisting of striga tolerant maize alone, and striga tolerant maize inter cropped with legume.
- Significant striga infestation and striga damages on maize when tolerant maize was inter-cropped with legumes.

Field days were organized in Cameroon (3 sites) and Nigeria. The objectives were to: 1) show and disseminate promising technologies to farmers and 2) facilitate further interaction among researchers, extensionists as well as participating and non-participating farmers in the community. During the field days, farmers, researchers and extensionists were able to interact on the outcome of the technology demonstration as well as the socio-economic factors in the acceptability of those technologies.

In general, farmers appreciated the improved technologies over the farmer practices and most of them indicated their willingness to participate in the next trial.

The following recommendations can be made:

1) Progress achieved in one year within focal countries were encouraging. It is recommended that more countries be included in the on-farm adaptative evaluation of integrated striga control packages.

2) In most countries, the trial did not cover all zones infested by *Striga hermonthica* and except for Nigeria, the number of trials conducted was small. It is recommended that the level of funding be increased so that each country could adequately cover all striga infested zones.

3) Except for the monitoring tour, there was not enough interaction between researchers from different focal countries. It is then recommended that annual workshops be organised to allow for such interactions and exchange of ideas.

4) In view of the impact obtained during the field days, it is recommended that all participating countries organise field days in selected areas of their countries.

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