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Semi – Arid Food Grain Research and Development
Recherche et Developpement des Cultures Vivrières dans les Zones Semi-Arides

STRIGA CONTROL PROJECT FOR SUSTAINABLE FOOD PRODUCTION IN SUB-SAHARAN AFRICA

A PROJECT PROPOSAL BY:
THE ORGANIZATION OF AFRICAN UNITY, SCIENTIFIC
TECHNICAL AND RESEARCH COMMISSION,
SEMI-ARID FOOD GRAIN RESEARCH AND DEVELOPMENT
(OAU/STRC-SAFGRAD)

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PROJECT TITLE: Striga Control for Sustainable Food Production in Sub-Saharan Africa.

BENEFICIARY COUNTRIES: Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ethiopia, Eritrea, Ghana, Kenya, Mali, Niger, Nigeria, Senegal, Sudan, Tanzania, Togo, Zimbabwe.

PHASE I: PROJECT LIFE: Three years.

IMPLEMENTATION COORDINATING AGENCY: The Semi-Arid Food Grain Research and Development Agency of the Organization of African Unity's Scientific, Technical and Research Commission (OAU/STRC-SAFGRAD).

STRIGA CONTROL PROJECT FOR SUSTAINABLE FOOD PRODUCTION IN SUB-SAHARAN AFRICA

I. BACKGROUND

In the next 30 years, the population of the sub-Saharan Africa is expected to reach about 1.3 billion. Consequently, there will be nearly 800 million additional people to feed and shelter. Unless food production in the sub-region is substantially increased, it is projected that cereals imports into Africa will increase from 12 million metric tons (*IFPRI and World Bank reports 1994)* to 27 million metric tons by the year 2025. This magnitude of deficit in cereal grain requirement would certainly exacerbate not only food insecurity but also malnutrition.

In sub-Saharan Africa, *Striga* together with its relative, Alectra vogelii is probably the most important single biological constraint to the production of major food crops including cereals (maize, sorghum and millet), grain legumes (groundnut, cowpeas and bambara nut). Two-third of the 73 million hectares devoted to cereal production in sub-Saharan Africa has been estimated to be situated in the areas where *Striga* is endemic (*M'Boob, 1988*), although the effects are most severe in the semi-arid areas where moisture and soil fertility are limiting. Recent surveys have also revealed wider distribution to areas that hitherto been thought to be free of *Striga* such as the higher rain areas of the coastal and derived savanna zones of Benin, Togo, Nigeria and Ghana (*Lagoke et al., 1992*). Rapid human population growth, and the resultant land pressure, together with increased demand for food in these ecological zones, have favoured high incidence of *Striga* as cropping systems changed from shifting cultivation to intensive agriculture with short or no fallow periods.

Yield loss estimates due to damage by *Striga* spp. and related species vary considerably, but it has been the estimated that, on the average, crop losses due to *Striga* in infested soils in Africa is about 40%(FAO, 1989), with total crop losses occurring when susceptible varieties one grown in heavily infested fields. In Eastern Africa (*Doggett (1975*) estimated 20 to 95 % yield losses for sorghum and millet. In Gambia 30 % loss in the yield of cereals has been reported (*Carson, 1989*). In Ghana, yield losses of 78 to 100 % in sorghum, maize and millet were observed under heavy soil infestations (*Bolfrey et al., 1989*). In Ethiopia, on heavily infested fields, 65 to 100 % yield loss of sorghum has been reported. In Burkina Faso, average yield losses of 30 to 48 % in susceptable cowpea cultivars infested by S. gesnerioides has been reported (*Aggarwal and Ouedraogo 1988, Muleba, 1993*). Farmers often abandon heavily infested fields, purely out of frustration (Emechebe et al., 1988) and unless such situations are prevented and, where they already exist reversed, through integrated control of these parasitic flowering plants, thousands of farming households in Africa will continue to abandon their lands.

2. PROJECT ACTIVITIES

2.1 Goal

The goal of the project is to improve the productivity of land ressources through effective management of *Striga* in crops, thereby ensuring sustainable increase in production of major food crops contributing to the wellbeing of small-scale farmers and food security in sub-Saharan Africa.

2.2 Objectives

The main objective of the project is to increase food production in order to attain food security in participating African countries through the implementation of collaborative activities among the national programmes and other relevant institutions for the development and transfer of technology for sustainable, integrated management of *Striga* in farms, thereby reducing food crop yield losses.

The specific objectives are to:

i) Identify Striga control components for the development of sustainable, technically feasible, and socio-economically acceptable integrated *Striga* management (ISM) packages for the African farmer.

ii) Increase awareness on the *Striga* problem within and among African countries so as to influence policy that can facilitate *Striga* control in participating countries.

iii) Strengthen the capabilities of the participating national programmes for *Striga* control activities through training and provision of critically needed financial and logistical back-stopping.

iv) Facilitate management, dissemination, and exchange of technical information among scientists, participating national programmes and relevant institutions through workshops, seminars, publications, etc.

v) Ensure effective transfer of integrated *Striga* management technology to the African farmer, using the IPM methodology.

2.3 Approach

No single country in sub-Saharan Africa has all the technical expertise to fully undertake various activities (such as, operational research, verification and validation, extension and traïning) necessary for the development of sustainable, integrated management of *Striga*. The activities will be implemented by multidisciplinary teams that will include agronomists, plant protection specialists,

Striga biologists, breeders, socio-economists, soil scientists, extension agents, etc. For each major crop commodity, researchers based in various national agricultural research and extension systems (NARES) and international agricultural research centres (IARCs) will constitute the multidisciplinary regional *Striga* control research team. Focal NARES (FN), however, would be established (as indicated in Table 1) to undertake operational research (OR) activities.

2.3.1 *Operational research (OR)*

Technological options to be tested by Focal NARES, at the Operational research (OR) level, to control *Striga* would be identified for each crop commodity, based on critical assessment of available technologies. Low and medium input requiring technologies would be identified. Six to twelve countries could participate on each commodity operational research. This approach would enable each country to identify integrated *Striga* control measures. The exchange of technical information among institutions throughout the region would be facilitated. Technologies for controling *Striga* would be assessed for their agronomic productivity, socio-economic feasibility and environmental friendliness.

Each focal NARES (FN) will serve as a centre for operational research. Using maize as an example, in West and Central Africa, the maize FNs are Cameroon, Ghana and Nigeria for the sub-humid and humid zones while the collaborating NARES will include Côte d'Ivoire, Benin, Togo, Congo, Gabon and Zaire. The maize FNs for Sudano-Sahelian zone could be Burkina Faso and Gambia; the collaborating NARES, (CN) will include, Senegal, Cameroon, Nigeria, etc. For mid-altitude zone, the FNs for maize operational research are Kenya, Tanzania and Zimbabwe, the CNs being Ethiopia, Uganda, Zambia and Cameroon.

For sorghum and millets in West and Central African ten NARS will collaborate in *Striga* control operational research namely, Nigeria, Cameroon. Burkina Faso, Chad, Mali, Ghana, Togo, Gambia, Benin, Senegal. In Eastern and Southern Africa, Sudan, Ethiopia, Tanzania and Zimbabwe will serve as FNs.

Several cowpea cultivars resistant or tolerant to *Striga* have been identified. Nigeria and Benin will be the focal NARES for the northern Guinea savanna, Burkina Faso and Mali for the Sudan savanna, and Senegal and Niger for the Sahelian zone.

The main thrust of operational research activities will include the following five projects (P-1 to P-5):

P-1 Evaluation of *Striga* resistant/tolerant elite cultivars at focal NARES.

P-2 Development of appropriate cereal/legume intercropping systems (i.e., trap crops for rotation and improved agronomic practices).

P-3 Soil fertility improvement (e.g., nitrogen fertilizers from both inorganic and organic sources).

P-4 Minimal use of chemical control (such as, seed treatment and post emergence applications).

P-5 Promotion of regional trials: Technology options identified from P-1 to P-4 will be made available to other NARES for testing through regional trials.

2.3.2 *On-farm verification trials*

The project addresses one of the most crucial challenges facing Africa, i.e., attaining food security. Food grains are the major staple crops for millions of people in Africa. Next to soil fertility related problems, *Striga* is the major biological constraint that increasingly threatens the production of cereals. This project links innovative approaches to overcome the problem. First, technologies that are identified through operational research would be further verified and validated on-farm by the researchers Second, farmers will be trained to carry out on-farm demonstration trials at village level using the IPM methodology. The short term objectives of the on-farm verification trials is to package technologies for an integrated *Striga* control on sorghum, maize, cowpea and millets (Annex 3). On-farm verification trials will be carried out in five countries for each crop commodity.

Technological options

The *Striga* control problem has long term perspectives. Various types of technologies will need to be assessed and packaged. As depicted in Annex 1, these technological options include:

i) Crop cultivars resistant/tolerant to Striga Several maize, sorghum and cowpea cultivars resistant to *Striga* have been identified (Annex 2)

ii) Crop rotation using cereals/legumes and cash crops. For example, trap crops, such as cotton, soybean, groundnut, sunflower and cowpea will be used to stimulate germination of *Striga hermonthica* seeds without being parasitized, thereby deplete the seed bank. Each participating country will determine the sequence and duration of the rotation and the time of sowing trap crops.

iii) Soil fertility improvement: In general, increasing nitrogen rates has been reported to decrease incidence of *Striga*.

iv) Appropriate cultural practices: Package for an integrated *Striga* control will include cultural practice specific to various agro-ecological sites. Recommended agronomic practices (e.g., plant density, date of planting, intercropping, etc.) will be developed for various cropping systems.

v) Chemical control: A number of broad leaf herbicides for use in *Striga* control in maize, sorghum and millet have been identified. Similarly, promising results have been obtained with seed treatment of host crops with some environmentally friendly aceto-lactase synthate inhitor compounds at very low rates. The use of chemicals, however, will be highly selective and minimal.

Inputs for on-farm verification demonstration trials:

i) Quality seed of *Striga* resistant/tolerant maize, sorghum, millets and cowpea cultivars will be provided to participating farmers. The seeds will be produced by contracting private farmers, national experiment stations and development agencies. The arrangement for seed production varies from country to country. The project may provide seeds for on-farm demonstration sites.

ii) Fertilizers - Farmers will be encouraged to procure their own organic and inorganic fertilizer.

iii) Extension agents based in villages will train farmers to execute on-farm verification trials.

iv) Field days will be organized to expose farmers to improved *Striga* control measures.

v) Audiovisual equipments - for facilitation the dissemination of information.

vi) Resources: farmers will provide plots of land and labour, but the project will cover costs of external inputs.

2.3.3 *Human resources development*

Training will include:

i) Training of trainers at regional level. This would be implemented in cooperation with organizations which have comparative advantage and capacity, such as IITA, ICRISAT, some NARS and Advanced Laboratories. In West and Central Africa, short-term training, lasting a few days to a week, on *Striga* research and control measures will be provided to 63, 50 and 45 techicians that will work on maize, millets and cowpea, respectively (Annex 3).

ii) Training at national level - Trainers who completed the regional course will train technicians of the respective national extension systems. Farmers to be trained will be selected by village communities. Trained farmers, will subsequently serve as extension contact point to facilitate the adoption of technologies for control of *Striga*. Over 6000 farmers will be trained through

on-farm trials, visits to operational research and demonstration sites, and video shows (Annex 3).

iii) Promote the realisation of national *Striga* research team. Appropriate training and workshop will be organized for researchers.

2.3.4 *Enhancing the exchange of technical information*

Thematic seminars, workshops, monitoring tours, etc. would be organised in order to:

- critically review results of operational research, on-farm trials and farm level verification and demonstrations;
- obtain feedback from farmer and extension agents as to relevance of technology introduced; and design trials for the subsequent season, taking into account various suggestions;
- strengthen technical linkages and feedback between research, extension and farmers; thematic workshops and seminars would be identified based on farmers problems and on researchable issues for controlling *Striga*.

2.4 *Expected outputs*

From the successful implementation of the project, the expected output include:

2.4.1 Building of national research capacity to alleviate the major biological, environmental, and socio-economic constraints to integrate control of *Striga*.

2.4.2 The delivery of improved technological packages or options for integrated *Striga* control, based on the needs and resources of poor farmers.

2.4.3 Minimize: (i) yield losses of food grains, (ii) degradation of land resources, and (iii) destruction of beneficial organisms and biodiversity.

2.4.4 Increase awareness of the need for *Striga* control at national and regional levels; technical information on *Striga* biology, extent of *Striga* infestation and crop yield losses, environmental degradation, etc.

2.4.5 Enhance participation of communities in the control of *Striga*; this includes occasional field campaigns.

Table 1

Striga Control Operational Research Focal Points

Crops	Focal NARES for Operational Research in Different Ecological Zones			
	Northern Guinea Savanna	Sudan Savanna	Mid-Altitude	Sahelian
Maize	Cameroon/ Ghana Nigeria	Burkina Faso Gambia	Kenya Zimbabwe Tanzania	-
Sorghum	Nigeria Cameroon	Mali and Burkina Faso	Sudan Ethiopia Zimbabwe Tanzania	Cameroon
Pearl and Finger Millets	- -	Tchad Sudan Nigeria	Ethiopia	Niger Senegal
Cowpea	Nigeria Benin	Burkina Faso Mali	Tanzania	Senegal Niger

3. PROJECT FINANCIAL REQUIREMENTS

3.1 *Project budget*

Striga research and control has long-term perspectives. While basic and applied research on *Striga* will continue in IARCs (IITA and ICRISAT), advanced laboraties and at few relatively strong NARES, the proposed budget (Annex 4) is to enhance the transfer of available technologies for integrated control of control *Striga*, in order to enhance the production of food grains. The proposed budget for the first phase of three years duration is about one million nine-hundred and seventy two thousand (1,972,000) US dollars. The three important project activities (i.e., operational research, on-farm verification trials, and capacity building) constitute about 60 % of estimated budget. About 29 % of the budget is for the implementation and coordination of project activities and for regional collaborative *Striga* research and control activities. About 13 % of the budget is proposed for administrative costs.

3.2 *Contribution from benefiting countries*

Participating countries will provide research infrastructure, administrative (support in the form of land, office space, salaries of research and technical staff), and matching funds for field level *Striga* control activities.

4. PROJECT MANAGEMENT AND IMPLEMENTATION

4.1 *Strategy*

Through operational research, the focal NARES will serve as centres for screening and evaluation of the suitability of available technological options for *Striga* control. Extensive on-farm verification demonstration trials for striga control would be carried out by collaborating NARES, involving the national extension system, NGOs and other development agencies, and farmers. IARCs (IITA, ICRISAT, CIRAD, CIMMYT, WARDA, etc.) will provide technical support to tackle the more complex constraints for controlling *Striga*, through basic and applied research and research capacity building for NARES.

4.2 *Management*

The project will be managed by OAU/STRC-SAFGRAD which has substantial experience in implementing regional collaborative research and development programmes. A *Striga* Task Force: (STF) comprised of 5 to 7 members from NARES, IARCs, SAFGRAD, etc. will be established.

The major functions of the STF are:

1) To set priorities for striga research and control based on identified constraints of regional dimension.

2) To review and approve annual striga research and control work programme.

3) To monitor the implementation of project activities.

4) To review project work progress and enhance regional cooperation among Focal and Collaborating NARES.

A regional coordinator will be recruited by the OAU/STRC-SAFGRAD, to effectively coordinate and monitor the implementation of project activities. Furthermore, SAFGRAD, as an Agency of the Organization of African Unity, will sensitize participating NARS governments to increase awareness about the severe crop losses caused by *Striga*.

Over the last 15 years, the OAU/STRC-SAFGRAD has developed one of the most efficient financial management systems. Project funds, therefore, will be managed by the SAFGRAD Coordination Office which will also provide training to NARES financial management units.

ANNEX 1. Sources of Technologies for Striga Control

Type of Technology		Extent of Technology Availability					Remarks
		Maize	Sorghum	Millet	Cowpea	Groundnut	
i)	Striga resistant or tolerant cultivars.	+ +	+ +	-	+ + +	-	Annex 2 indicate resistant cultivars for sorghum, maize and cowpea.
ii)	Cultural practices	+ +	+ +	+	+ + +	-	
iii)	Fertilizers	+ +	+	+	+	-	Nitrogen (40 to 90 kg N/ha) in the form urea, depending on soil types and crop. Combination of mineral and organic source of fertilizer is recommended.
iv)	Chemical control	+	-	-	-		Limitation due to economic feasibility and environmental concern.
v)	Weeding (hand and mechanical)	+	+	+	+		Limitation due to availability of labour.

\- Technologies not available, rather being researched.

\+ Some technologies available but need to be more evaluated both on station and on-farm level.

\+ + Adequately, tested on station and need to be more verified and packaged at on-farm level.

\+ + + Broader choice of technologies at on-station level, but require more verification at on-farm level, to determine both economic feasibility and environmental adaptability.

ANNEX 2: Some *Striga* resistant/tolerant cultivars of sorghum, maize and cowpea in West and Central Africa.

Sorghum	Maize	Cowpea
S-35	9022-13 STR	IT90K-1026
CS-54	9021-18 STR	IT90K-59-2
CS-95	9044-15 STR	IT90K-59-4
ICSV-1079	STR-SYN-W	IT90K-82-2
IS-7777	TZPB-SR-STR	IT89KD-245
IS-1260	8425-8	IT89KD-245-1
IS-98-30	9044-27 STR	IT81D-994
SAR-19	ACC-93-TZL	IT81D-985
SAR-29	ACC-92-TZE	TN93-80
SAR-33		TN121-80
SPL38AX x SAR-29		KVx61-1
SRN-39		KVx61-74
		IT81D-994
		KVx100-21-7
		Suvita 2
		IT90K-77
		IT82D-849
		KVx402-19-1
		KVx402-19-5

Source: Integrated management of *Striga* for the African farmer, Third PASCON Workshop, 1993. SAFGRAD Phase II report 1987-1991.
S.K. Kim, 1995a

ANNEX 3. Training of Technicians and Farmers of Striga Control Project in Selected Countries of Sub-Saharan Africa (1996/1999)

West and Central Africa	Maize	Sorghum	Millets	Cowpea	Total Number Villages	Farmers Training
Benin	5	–	–	3	8	350
Burkina Faso	5	10	5	10	30	600
Cameroon	10	10	–	5	25	500
Ghana	10	5	–	5	20	400
Mali	5	10	10	5	30	600
Niger	–	–	10	10	20	400
Nigeria	10	10	10	10	40	800
Côte d'Ivoire	10	–	–	–	10	200
Senegal	3	–	10	5	18	360
Togo	5	5	–	5	15	300
Sub-Total	63	50	45	58	216	4510
East and Southern Africa						
Kenya	10	–	–	–	10	200
Ethiopia	10	10	10	–	30	600
Sudan	–	10	10	–	20	400
Tanzania	10	5	–	2	17	340
Zimbabwe	10	5	–	–	15	300
Sub-Total	40	30	20	2	92	1840
Grand-Total	103	80	65	60	308	6350

It is assumed that training for large number of technicians would be needed in the next five years. As the project being implemented each participating country could also determine its manpower requirements for Striga control both at research, extension and farmers levels.

ANNEX 4 - Phase I (1997/1999) - Budget Estimate in Thousands US Dollars for *Striga* Control Operational Research on-Farm Demonstration Trials in Selected Countries of Sub-Saharan Africa

PROJECT ACTIVITIES	No. FN	No. CN	YEAR 1	YEAR 2	YEAR 3	TOTAL	%
I. Operational Research							
1. Maize	4	8	70	60	60	190	
2. Sorghum & Millets	3	8	50	50	40	140	
3. Cowpea	3	7	40	30	35	105	
Sub-Total			160	140	135	435	22.06
II. On-farm Verification & Demonstration Trials							
1. Sorghum & Millets			60	55	60	175	
2. Maize			60	60	65	185	
Sub-Total			120	115	125	360	18.25
III. Capacity Building							
1. Training			35	30	35	100	
2. Workshops & Seminars			40	40	40	120	
3. NARES Research Staff exchange			40	40	40	120	
Sub-Total			115	110	115	340	17.24
IV. Operation Costs							
1. Coordination & Management			90	75	75	240	
2. Equipment & Supplies			55	30	25	110	
3. Travel			50	55	45	150	
4. Publications			25	25	30	80	
Sub-Total			220	185	175	580	29.41
TOTAL			615	550	550	1,715	
Administrative Costs 15%			92.25	82.50	82.50	257.25	13.04
GRAND TOTAL			707.25	632.50	632.50	1,972.25	100

FN = Focal NARES
CN = Collaborating NARES

A C R O N Y M S

CIMMYT	Centro International de mejoramineto de Maiz y Trigo
CN	Collaborating NARES.
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement.
FAO	Food and Agricultural Organization of the United Nations.
FN	Focal NARES.
IARCs	International Agricultural Research Centre.
ICRISAT	International Crop Research Institute for Semi-Arid Tropics.
IFPRI	International Food Policy Research Institute.
IITA	International Institute of Tropical Agriculture.
IPM	Integrated Pest Management.
ISM	Integrated Striga Management.
NARS	National Agricultural Research Systems.
NARES	National Agricultural Research and Extension Systems.
NGOs	Non-Govermental Organizations.
OR	Operational Research.
OAU	Organization of African Unity.
SAFGRAD	Semi-Arid Food Grain Research and Development Agency.
SSA	Sub-Saharan Africa.
STF	Striga Task Force.
STRC	Scientific, Technical and Research Commission.
WARDA	West African Rice Development Association.

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