# Integrated Striga Control Using the Participatory Research and Extensive Approach in Hong Local Government Area of North-Eastern Nigeria

Garba, Yusuf Mwada, Wamdudi, Daniel Kevin, Ahmed Usman*, Lebiso, I. Joel, Geoffrey Katsala Jiguda

*Department of Agricultural Education, School of Vocational and Technical Education, Adamawa State College of Education, Hong, Nigeria*

**Corresponding Author*

***Abstract*: - The study examines the Integrated Striga Control Using the participatory Research and Extensities Approach in Hong Local Government Area of North-Eastern Nigeria. It adopted experimental design of Randomized Complete Block Design made up of ten treatments. A one-way ANOVA was used to examine the statistical mean differences among the treatments in relation to reduction of the number of striga plants in maize and sorghum trial plots. The results shows maize and sorghum cultivated with urea were statistically significant with (F(23,48)= 4.626) and (F(23,48)= 2.420) respectively, which implies that urea as nitrogenous fertilizer induces reduction in the incidence of striga emergence in the farm. It further shows maize inter-cropped with soya beans and sorghum inter-cropped with soya bean were statistically significant with (F(23,48)= 2.246) and (F(23,48)= 2.912) respectively, which signifies that soya bean inter-cropped with maize and sorghum suppresses the emergence of striga in the farm. Similarly, the result shows significant reduction of yield and qualities of grains in maize and sorghum in the treatment of maize sown sole, sorghum planted sole, sorghum cowpea, maize cowpea while maize and sorghum grew with urea account for higher yield followed by those grown with manure and those inter-cropped with soybeans being the least and their grain qualities recorded highs. This may be due to the nutrient contents (Nitrogen) of the treatment and fixation of nitrogen by the soybean which made surplus nutrients to the crop plants and parasitism plants (striga) and thereby reduces its infestation. The results further revealed that maize and sorghum plants grown with manure and urea were vigourous. Lastly, it also shows strong negative correlation between the yield and number of striga (-0.48).The use of organic manure improves soil structure making nutrients as well as water available to crop plants thereby enhances roots and stem development. Farmers should adopt the use of nitrogenous fertilizer at recommended rate and cultivate maize or sorghum inter-cropped with soybeans as well as the use of organic manure to improve soil structure and enrich the soil.**

***Keywords*: Integrated, Striga, Participatory, Research**

## I. INTRODUCTION

Striga belongs to the family Scrophalriacae with about 50 species. They are obligate parasites on other plants, Doggett (1984). Striga is an endemic parasite weed of SubSaharran Africa which is steadily increasing its geographic domain and level of infestation bewitching crops, greatly and continuously reducing yield(Franke *et al.*,2004). The weed survives by siphoning off water and nutrients from the crops for its own growth. It causes serious damage to its host crop before emerging from the soil by producing phytotoxins which are harmful to the host crop. Upon attachment to host roots, it withdraws photosynthate, minerals and water, resulting in characteristic ‘’witch” appearance of the host crop manifested by stunting and withering. Crops mostly affected are maize, sorghum, sugarcane, millet, rice, legumes and other weedy grasses. Affected crops show stunted growth, wilting, yellowing, scourging of leaves, low yield and death (Kamal *et al.*,2001).

Chikoye *et al.* (2004) had reported that about 300 million people in Sub-Saharan Africa are being adversely affected by Striga on 50 million hectares of cropland showing degrees of infestation. 60-70% grain yield losses have been reported in Africa. Doggett (1984). Striga seriously undermines the struggle to obtain food security and economic growth in the African continent, Ellis-Jones, (2003). Striga is one of the root causes of hunger and poverty amongst small scale farmers in Africa and Nigeria in particular especially the north-east region. The Striga problem in the north-east of Nigeria is exasperated by its exquisite adaptation to the climatic conditions of the semi-arid, high fecundity and longevity of its seed reserve in the tropical soils. The problem has been aggravated over the years as a result of indiscriminate purchase of Striga-infested seeds, continuous cultivation of susceptible varieties of crops, uncontrolled grazing and non-adaptation of Striga management strategies, Chikoye*et al.* (2004). This problem is practically more serious in Adamawa state especially Hong Local Government due to the farming system and increase in population. The control of Striga is difficult through conventional hand and mechanical weeding because the greatest damage occurs before emergence, Franke *et al.* (2004). It is essential to control Striga through adoption of measures that aim at reducing the level of Striga seed inoculums in the soil(Carsky *et al.*,2000). Different Striga control technologies have been advocated including crop rotation involving legumes, trap cropping, and intercropping cereals with legumes, multi-year fallow and push-pull strategies. Combining a range of individual component technologies into integrated packages provide flexible and sustainable control over a wide range of biophysical and socio economic environments. Schulz *et al. (2003).* The participatory research and extension approach (PREA) is found to be the most appropriate system for adoption of Striga control technologies. This approach enables superior technologies to be exposed more widely to the diverse farming conditions and accelerated the rate of technological adoption (Chikoye *et al.*,2004).

Poverty remains the greatest hurdle to improving the quality of life of the poor- resource farmer in Africa. Striga is one of the root causes of hunger and poverty amongst the small scale farmers in Africa. Striga infestation is devastating when the land is poor (infertile), management being poor and the fewer the inputs which are characteristics of the North-East region of Nigeria's position. Striga results in 60-70% grain losses in this region. The strategy to reduce poverty is through agriculture: the production of more and better quality food winch leads to food security and provide opportunities to enhance income. Good farming practices and ample inputs can keep down Striga attack. Management of Striga is difficult because the majority of its life cycle takes place below ground and the greatest damage occurring before emergence. The most promising method of control is to aim at reducing the number of Striga seeds in the soil which can be achieved with the knowledge that (i) Striga being an obligate parasite produces seeds only on suitable host plant, (ii) germinated Striga dies in the absence of the host and (iii) rotating cereals with legumes stimulates germination of Striga seeds hut fails to emerge (legumes being unfavorable hosts). To achieve this, the integrated Striga control (ISC) methods through participatory research and extension approach (PREA) will be used. The aim of the study is to examine the effective means of controlling striga through well managed practices and measures that fit the local farmers' knowledge. It determine the effect of several technologies (treatments) on the incidence of Striga plant development, the rate of Striga (seed bank) reduction on a field due to a technology, the effect of a technology on the grain yields of maize crop and the worthwhile (acceptability) of a technology to farmers in a community.

## II. MATERIALS AND METHOD

### *2.1 Experimental Sites*

The participatory research and extension approach (PREA) to integrated Striga control (ISC) methods was conducted in seven (7) Districts of Hong Local Government area of Adamawa State, Nigeria. The area is geographically located on latitude $10^0$15" N and longitude 13°12" E and has an average rainfall of 1016 mm per annum and temperatures of' between 26.5 - *3* 0.0°c on an altitude of 246m above sea Level in the Northern Guinea Savannah. The soil of this area is characteristically sandy loam.

An integrated Striga control methods was employed involving the following materials:-

i. a local Striga susceptible maize
ii. a local Striga susceptible sorghum
iii. Two legume trap-crops: soybean and cowpea.
iv. Urea fertilizer
v. goat/sheep manure
vi. compound fertilizer (NPK)

### *2.2 Experimental Design*

A randomized complete block design (RCBD) was used for the experiments. Replications were in the form of three selected farmers per village. Each farmer/block wasassumed as a replication. Ten treatments were used in the study, thus; Maize: local Striga susceptible variety grown as sole crop, Sorghum: local Striga susceptible variety grown as sole crop, Cowpea sole crop, Soybean sole crop, Maize intercropped with cowpea, Sorghum intercropped with cowpea, Maize intercropped with soybean, Sorghum intercropped with soybean, Maize fertilized with urea, Sorghum fertilized with urea, Maize fertilized with goat/sheep manure and sorghum fertilized with goat/sheep manure.

### *2.3 Cultural Practices*

Each selected farmer was asked to provide a land that is exhausted (infertile and has serious incidence of Striga). Farms (blocks) were ridged at 75cm spacing using bull-driven ploughs in July each year maize and cowpea will be planted at an intra row spacing of 50cm. Soybean will he drilled and thinned to intra row of 5cm. Cowpea sowing was delayed 2 weeks after the others.

*Weeding:* Maize plots were hoe-weeded 2 WAS. Later, weeds other than Striga were hand pulled. Legumes weeded u at 3 and 6 WAS.

*Fertilization:* Maize applied 120 kg NPK/ha at sowing. Legumes were supplied with 55kg NPK/ha mixed with SSP at sowing. Cowpea were sprayed with a mixture of 30 kg a.i. /ha of Cypermethrin and 250 kg a.i. /ha of Dimethoate at flowering and podding to control diseases and pests.

### *2.4 Data Collection*

Data were collected on the incidence and the extent of striga damage on crops. These include:

1) Striga count at 9 WAS by counting the number of striga plants in a plot each season.
2) Crop vigour score at 9 WAS by assessing the vigour of sampled maize stands on a rating scale of not vigourous (NV), vigorous andhighly vigorous.
3) Grain yields by harvesting a crop, processing to obtain grains which were weighed using a scale in kg each season.

### *2.5 Data Analysis*

Data collected were analysed usingANOVA (Analysis of Variance) at 5% level of significance for the effects of different treatments on the emergence of striga, rating scale was used to analyze vigorisity of sorghum and maize plants and the relationship between number of striga plants and yield was achieved by rank correlation.

## III. RESULTS AND DISCUSSIONS

### *3.1 Effects of Different Treatments on the Emergence of Striga on Maize and Sorghum*

A one-way ANOVA was used to examine the statistical significant differences among the treatments in relation to reduction of the number of striga plants in maize and sorghum. Table 1 revealed that maize and sorghum cultivated with urea were statistically significant with (F(23,48)= 4.626) and (F(23,48)= 2.420) respectively. Therefore, null hypothesis is rejected, as urea had significant relationship in suppressing striga emergence. This implies that urea as nitrogenous fertilizer induces reduction in the incidence of striga emergence in the farm. This is similar to the findings of Alpha *et al*. (2020), and Kamara *et al.* (2009) which in their experiments show nitrogen application reduces the number of emerged striga.

The result from Table 1 also shows that maize inter-cropped with soya beans and sorghum inter-cropped with soya bean were statistically significant with (F(23,48)= 2.246) and (F(23,48)= 2.912) respectively. This signifies that soya bean inter-cropped with maize and sorghum suppresses the emergence of striga in the farm. This is in line with the finding of Kureh *et al.* (2000) who found that maize intercropped with soybeans significantly reduced number of striga emergence.

The Table further disclosed that treatments such as maize sown sole, maize inter-cropped with cowpea and maize grown with manure were not statistically significant.

Table 1: Analyses of Variance for the Effects of Different Techniques on the Control of Striga

| Source of Variance | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| $M_{sole}$ | Between Groups | 178792.967 | 48 | 3724.853 | .746 | .806 |
| | Within Groups | 114799.033 | 23 | 4991.262 | | |
| | Total | 293592.000 | 71 | | | |
| $M_{urea}$ | Between Groups | 193777.111 | 48 | 4037.023 | 4.628 | .000*** |
| | Within Groups | 20061.333 | 23 | 872.232 | | |
| | Total | 213838.444 | 71 | | | |
| $M_{cowpea}$ | Between Groups | 74801.500 | 48 | 1591.521 | 1.006 | .478 |
| | Within Groups | 37952.000 | 23 | 1581.333 | | |
| | Total | 112753.500 | 71 | | | |
| $M_{manure}$ | Between Groups | 47780.867 | 48 | 995.435 | 1.046 | .467 |
| | Within Groups | 21884.633 | 23 | 951.506 | | |
| | Total | 69665.500 | 71 | | | |
| $M_{soya}$ | Between Groups | 61626.153 | 48 | 1311.195 | 2.246 | .009*** |
| | Within Groups | 14011.167 | 23 | 583.799 | | |
| | Total | 75637.319 | 71 | | | |
| $S_{sole}$ | Between Groups | 75233.444 | 48 | 1567.363 | 2.013 | .036 |
| | Within Groups | 17905.667 | 23 | 778.507 | | |
| | Total | 93139.111 | 71 | | | |
| $S_{manure}$ | Between Groups | 29148.308 | 48 | 607.256 | .760 | .792 |
| | Within Groups | 18386.567 | 23 | 799.416 | | |
| | Total | 47534.875 | 71 | | | |
| $S_{urea}$ | Between Groups | 57527.633 | 48 | 1223.992 | 2.420 | .005** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Within Groups | 12137.867 | 23 | 505.744 | | |
| | Total | 69665.500 | 71 | | | |
| $S_{soya}$ | Between Groups | 181937.078 | 48 | 3871.002 | 2.912 | .000*** |
| | Within Groups | 31901.367 | 23 | 1329.224 | | |
| | Total | 213838.444 | 71 | | | |
| $S_{cowpea}$ | Between Groups | 55703.411 | 48 | 1160.49 | .0 | .793 |
| | Within Groups | 37435.700 | 23 | 1627.64 | | |
| | Total | 93139.111 | 71 | | | |

Key: $S_{soya}$ - sorghum soya bean, $M_{soya}$- Maize soybean, $S_{cowpea}$-Sorghum cowpea, $S_{urea}$- Sorghum urea, $M_{sole}$- Maize sole, $M_{urea}$– Maize urea, $M_{cowpea}$– Maize cowpea, $M_{manure}$- Maize manure, $S_{manure}$- Sorghum manure, $S_{sole}$-Sorghum sole.

*** Significant at 1%.

### *3.2 Effects of Different Treatments on the Vigour of Maize and Sorghum Plants*

In Table 2, it shows the vigorisity of maize and sorghum plants which were rated using rating scale of highly vigourous, vigourous and not vigourous. Hence, treatment that has less than 2 mean score is said to be not vigourous and greater than equal to 2 mean score is vigorous. The results revealed that maize and sorghum plants grew with manure and urea were vigourous. While maize planted sole, sorghum planted sole, sorghum and maize planted with cowpea as well as maize and sorghums own with soybean were not vigorous. This implies that nutrients availability in the soil enhances plants to grow vigorously in as much that they are readily available to the growing plants. Also, the use of organic manure improves soil structure making nutrients as well as water available to crop plants thereby enhances roots and stem development. This is in line with the findings of Wamduda (2014).

Table 2: Effects of Different Treatments on the Vigorisity of Maize and Sorghum Plants

| Treatments | Highly Vigorous | Vigorous | Not Vigorous | Mean Score | Decision |
|---|---|---|---|---|---|
| $M_{sole}$ | 4 | 2 | 30 | 1.28 | Not Vigorous |
| $M_{urea}$ | 23 | 8 | 5 | 2.50 | Vigorous |
| $M_{cowpea}$ | 3 | 3 | 30 | 1.25 | Not Vigorous |
| $M_{manure}$ | 18 | 12 | 6 | 2.33 | Vigorous |
| $M_{soya}$ | 6 | 5 | 25 | 1.47 | Not Vigorous |
| $S_{sole}$ | 2 | 4 | 30 | 1.22 | Not Vigorous |
| $S_{manure}$ | 21 | 13 | 2 | 2.53 | Vigorous |
| $S_{urea}$ | 23 | 11 | 2 | 2.58 | Vigorous |
| $S_{soya}$ | 11 | 2 | 23 | 1.67 | Not Vigorous |
| $S_{cowpea}$ | 5 | 7 | 22 | 1.42 | Not Vigorous |

Key: $S_{soya}$ - sorghum soya bean, $M_{soya}$- Maize soybean, $S_{cowpea}$-Sorghum cowpea, $S_{urea}$- Sorghum urea, $M_{sole}$- Maize sole, $M_{urea}$– Maize urea, $M_{cowpea}$– Maize cowpea, $M_{manure}$- Maize manure, $S_{manure}$- Sorghum manure, $S_{sole}$-Sorghum sole.

### *3.3 Effect of striga on the Yield of maize and sorghum*

The result shows significant reduction of yield and qualities of grains in maize and sorghum in the treatment of maize sown sole, sorghum planted sole, sorghum cowpea, maize cowpea while maize and sorghum grew with urea accounted for higher yield followed by those grown with manure and those inter-cropped with soybeans being the least and their grain qualities recorded high. This may be due to the nutrient contents (nitrogen) of the treatment and fixation of nitrogen by the soybean which made surplus nutrients to the crop plants and parasitism plants (striga) and thereby reduces its infestation. This finding corresponded with the trial of Kureh *et al.* (2000) which stated that sole maize grown with soybeans exhibited greater crop syndrome reaction and produced significantly lower grain yields than when intercropped with soybeans varieties.

Spearman's rank correlation was used to examine the relationship between average number of striga emerged and yield of maize and sorghum. The result shows weak negative correlation between the variables with correlation value -0.48.

This implies that high striga infestation reduces yield of maize and sorghum drastically.

Table 3:Effect of striga on the Yield of maize and sorghum (kg)

| Yield (Y) | Emerged Striga (S) | Y Rank | S Rank |
|---|---|---|---|
| 5.8 | 85.4 | 4 | 3 |
| 10.6 | 34 | 1 | 9 |
| 4.9 | 7 | 5 | 10 |
| 2.4 | 59.4 | 10 | 7 |
| 3.6 | 72.4 | 8 | 4 |
| 4 | 134.6 | 7 | 2 |
| 6.8 | 65 | 3 | 6 |
| 3.6 | 222 | 8 | 1 |
| 9.8 | 44 | 2 | 8 |
| 4.7 | 71.4 | 6 | 5 |
| Correl | | -0.48 | |

## IV. RECOMMENDATIONS

On the basis of the findings in order to ensure decline in the emergence of striga and to gain bumper harvest, we recommend the following:-

i. Farmers should adopt the use of nitrogenous fertilizer at recommended rate.
ii. They should cultivate maize or sorghum inter-cropped with soybeans.
iii. Farmers should ensure that there is an available nutrient on their farm through the use of organic manure that improves soil structure and enrich the soil.

## V. CONCLUSION

The manifestation of striga on maize and sorghum farm affect plants growth and the yield. With the used of nitrogenous fertilizers and soybean suppressed the emergence of striga plants thereby the output/yield from such crops is optimum. Therefore, nutrients availability in the soil promotes crop growth and development leading to high yield. Similarly, use of organic manure improves soil structure and makes plants grow vigorously with increased yield.

## REFERENCES


[1]. Alpha, Y. K., Abebe, M. Davvid, C., Abdullahi, I. T., Aminu A. F., Rabiu, D., Reuben, S., Temitope, A., Lucky, O. Kamaluddin, T. A. and Nkeki, K. (2020).Mitigatingstrigahermothica parasitism and damage in maize using soybean rotation, nitrogen application and striga resistant varieties in th Nigeria Savannas. Cambridge University Press

[2]. Carsky, R.J., D.K. Berner, B.D. Oyewale, K. Dashiell and S. Schulz (2000).Reduction of strigahermonthica parasitism on maize using soybean rotation. International Journal of Pest Management 46: 115-120.

[3]. Chikoye D. (2004).Reducing poverty through improved Striga control. Edited by I). Chikoye. .1. Ellis-Jones, ***(3.*** Tarawali. and A.F. LumIn: Integrating New fechnologies For Striga Control - Towards Ending the Witch-Hunt. Proceed ingsoF the second Siriga management siakeholders conference 8-9 September 2004Zaria. Kaduna State. Nieria.

[4]. Doggett H. (1984). Striga - Its Biology And Control An Overview In: StrigaHiolog' And Control Edited By : E.S. Aensu H. DoggetiR.l). Keynes J. Marton-Lefevre Li. Musselman C. Parker A. Pickering. lcsu Press International Development Research Centre Ellis—Jones .1. ***2003.*** Promoting integrated Striga management practice in maize in northern Nigeria. Pages 1023 1028 in 2003 Brighton Crop Protection Conference Weeds. Proceedings o1 an international conference, I7-20 November 2003. Brighton.British Crop Protection Council, Farnham, Surrey, UK.

[5]. Ellis-Jones J., D. Chikoye, A. Emechebe, L. Franke, M. Hussaini, 1. Kureb, 1. Odunze. A.S. Olanrewaju. and G. Tarawali (2003).Assessing the impact of a participatory approach for integrated Striga control: an ex-ante impact assessment and some policy implications, in: Integrating New Technologies For Striga Control - Towards Ending the Witch-Hunt.

[6]. Franke A.C., J. Ellis-Jones, M.A. Hussaini, I. Kureh, G. Tarawali, D. Chikoye, S. Schulz, .D. Oyewole, and R. White (2004).Dissemination of integrated Strigahermonthica control technologies through on-farm trials in the savanna zone ol northern Nigeria in: integrating New lechnologies 1-or Striga Control - Towards Ending the WitchHunt.

[7]. Kamara, .J.. h. Chuma. K. Murvira and Connolly, M. (2009). Putting Process into Practice: operationalizing Participatory Extension. In ODI Agricultural kesearch and Extension (AGREN) Network Paper no. 4. Overseas Development Institute, London.

[8]. Karnal I.M., Lytton J.M.. and Charles R.R. (2001).The Genus Striga (Scmphulariaceae) in Africa.Annals of the Missouri Botanical Garden, vol.88 (1).

[9]. Kureh, D. I., Emechebe, A.M., J. Ellis-Jones. S. Schulz, D. Chikoye, B. (. Tarawali. A.M. Hussaini. P. Kormawa, and A. Sanni. (2000). Farmers' perception ol the Striga problem and its control in northern Nigeria. Experimental Agriculture 40:215-232.

[10]. Schulz. S.. M.A. Husaini. J.G.Kling, D.K. l3erner, B.D. Ikie (2003). LaIuationol' integrated Strigahermonthica control technologies under farmer management. Experimental Agriculture, 39: 99-108.

[11]. Wamduda, D. K. (2000). Participatory Farm Management Methods for agricultural research and extension: a training manual. AERI)l), University ***of'*** Reading. U.K.