Combating the Menace of *Striga hermonthica* Infestation: An Integrated Approach Adopted in North-Eastern Ghana

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**Abstract:** The objectives of this study are to promote the growing of striga tolerant maize varieties in striga endemic locations of Northern Ghana. Three striga tolerant/resistant maize (STR) varieties, ACR 94 TZE Comp 5-W, ACR 97 TZL Comp 1-W and IWD STR C1, were grown in rotation and in intercropping with soybean, TGX 1442-2E, in 2003, 2004 and 2005 on farmers’ fields. Striga incidence was recorded as the number of striga plants at ten weeks after planting, visible effects due to striga, height of maize and maize grain yield. The results showed that the STR varieties grown in sole cropping supported few striga plants and produced up to 70% more grain than the farmers’ maize. The maize grown under intercropping supported fewer striga plants compared to those grown in sole cropping. STR grown in intercropping with soybean lead to a reduction of 17.6% emerged striga plants while when grown in rotation for three seasons had up to 89.4% less emerged striga plants as compared to maize grown after maize. Therefore, the growing of STR varieties in rotation with soybean may be one of the best and practical methods of control.

**Key words:** Maize, striga, tolerant/resistant, cropping system

**INTRODUCTION**

*Striga* species are known to cause serious economic losses to cereal crops such as millet, sorghum and maize. Among the known species, *Striga hermonthica* (Del.) Benth. of the Scrophulariaceae family, constitutes the most economically important biological constraints to maize production in Ghana. The prevalence of *Striga hermonthica* (striga shall be used) was not known in maize in Ghana, but as the cultivation of maize and the release of hybrid maize have been accepted nation-wide. The gravity of the situation has also become a reality with the droppings of migratory animals from neighboring Sahelian countries where the parasitic weed is really a menace to cereal production. Striga infestation accounts for seven billion US dollars of food production annually (Kim et al., 2004). In order to reduce losses due striga infestation, hand pulling and hoe weeding (Thalouarn and Fer, 1993), intercropping with trap and catch crops (Logake et al., 1991) application of high doses of nitrogen fertilizers (Carson, 1989) and herbicide application are among the most common control methods practiced by farmers. These control methods are either impractical or labor intensive to the capital deficient farmers. Okonko (1987), Heller and Wegmann (1999) have demonstrated that, for each of the five stages of striga parasitic development which include, striga seed germination, haustorial initiation, penetration of host root tissues, physiological compatibility and parasitic growth and maturity, to be completed, enzymes play a major role. Hence maize varieties with the genes controlling the expression of parasitic weed germination and development would be very important in controlling striga infestation. The control of striga had been through cultural methods because of the lack of resistant maize varieties. As the International Institute of Tropical Agriculture started developing these varieties a more practical method of control is to grow resistant maize varieties. In the absence of absolutely resistant varieties Kim (1994) has recommended the adoption of host tolerance that is controlled by quantitatively inherited genes whose expression depends on the environmental conditions. Growing maize in association with trap and catch crops may provide an environment not conducive to striga infestation.

Therefore, the objectives of this research were to promote the growing of striga tolerant maize varieties and to practice some integrated control methods in striga endemic locations of North-Eastern Ghana.

**MATERIALS AND METHODS**

This study was carried out in four districts in Guinea and Sudan Savannah zones of Ghana (between long 1°W and 1°2°E and between lat 9°N and 11°N) from 2002 to 2005. Three striga tolerant/resistant (STR) maize varieties,
RESULTS AND DISCUSSION

The participating farmers were selected based on, i. their previous involvement in some demonstrations, ii. how severe their farms were endemic to *Striga hermonthica* infestation, iii. the willingness to cooperate with the scientists and iv. availability of the Agricultural Extension Agents (AEA) of the Ministry of Food and Agriculture (MOFA) in the area to facilitate in data collection. The number of farmers who participated in the demonstrations from 2003 to 2005 across the districts is presented in Table 1. In 2003, the number of farmers who agreed to do the rotation demonstration was high, but the number went down in 2004 and further down in 2005. This could be due to the fact that small holder farmers do not embrace sole cropping even with all its advantages such as planting and harvesting. On the other hand the number of farmers willing to adopt the intercropping method remained fairly constant. Therefore, as the study period progressed some of the farmers were replaced when conditions changed. Those who were replaced had no option but to adopt the intercropping system because data from an incomplete rotation could not be analyzed.

There were significant differences (p<0.05) for plant height from farmer to farmer for each variety (Table 2). This was due to the varied management ability of the farmers. The farmers’ variety was usually taller (161.8 cm) than the striga tolerant varieties (134 to 138 cm). The farmers’ variety was also an improved variety that had lost its identity and was not tolerant to striga. It was not uniform but could produced economic yields under favorable conditions.

When the data of the intercropping plots were analyzed, there were significant differences (p<0.05) among the varieties with respect to days to silk extrusion and plant height. The number of striga plants that emerged twelve weeks after planting varied from district to district and tended to decrease from year to year. On the other hand many more striga plants emerged from the sole cropping system than the intercropping system. This was due to the fact that soybean is a trap crop that triggered the suicidal germination of some of the striga seeds in the intercropped plots before the host maize roots got to them. In intercropping, the reduction was not prominent. However, STR maize varieties grown in intercropping system lead to a reduction of about 17.6 % by the third year (Table 3) intercropping with soybean (Table 3).

Fewer striga plants emerged in the STR maize plots than the farmers’ variety plots at all districts (Table 4). The emerged striga plants per hectare at Bawku district was 36,700 and 24,900 for the farmers’ and STR maize
Table 1: Number of farmers that participated in demonstration in some districts from 2003 to 2005

<table>
<thead>
<tr>
<th>District</th>
<th>Intercropping</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamale</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Tolon-Kumbungu</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Yendi</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Bawku east</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Bawku west</td>
<td>4</td>
<td>7</td>
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<tr>
<td>Gushiegu</td>
<td>29</td>
<td>24</td>
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</tbody>
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Table 2: Means of farmers’ maize variety evaluated in intercropping from 2003 to 2005

<table>
<thead>
<tr>
<th>District</th>
<th>2003 (kg ha⁻¹)</th>
<th>2004 (kg ha⁻¹)</th>
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<th>2012 (kg ha⁻¹)</th>
<th>2013 (kg ha⁻¹)</th>
<th>2014 (kg ha⁻¹)</th>
<th>2015 (kg ha⁻¹)</th>
<th>2016 (kg ha⁻¹)</th>
<th>2017 (kg ha⁻¹)</th>
<th>2018 (kg ha⁻¹)</th>
<th>2019 (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bawku</td>
<td>400 (760)</td>
<td>430 (760)</td>
<td>450 (760)</td>
<td>500 (760)</td>
<td>550 (760)</td>
<td>600 (760)</td>
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<td>1050 (760)</td>
<td>1100 (760)</td>
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<tr>
<td>Tamale</td>
<td>400 (760)</td>
<td>430 (760)</td>
<td>450 (760)</td>
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<tr>
<td>Tolon-Kumbungu</td>
<td>400 (760)</td>
<td>430 (760)</td>
<td>450 (760)</td>
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Table 3: Means of stiga tolerant variety evaluated in intercropping from 2003 to 2004

Table 4: Means of all maize varieties evaluated in rotation from 2003 to 2005

varieties, respectively, in 2003. In Tamale district, the emerged stiga plants were 4,900 and 3,750 for the farmers’ variety and STR maize, respectively. By the third year of the study, the number of emerged stiga plants for both maize types had reduced to less than 550 plants per hectare. For the STR maize there was a reduction of about 89.4% emergence compared to the first year of the rotation (Table 4).

Grain production for the crops was best in Yendi district than all the other districts (Table 2 and 3) for intercropping but no data were available for completion of the study in that district. Maize grain production was better at Tamale district than the rest of the districts during the three years the study was carried out. In fact, Tamale district is in a high producing environment compared to Bawku which is in a low yielding one for maize. However, the farmers in Bawku district have started commercial cultivation of maize because of the relatively high yield compared to the substitute pearl millet due to stiga infestation. When the farmers’ variety was compared to the STR, at each district the STR produced higher grain that the farmers’ variety even when stiga infestation rates were comparable. In Bawku district, the grain produced by the farmers’ variety in rotation increased from 650 kg ha⁻¹ in 2003 to 725 kg ha⁻¹ in 2004 and to 1000 kg ha⁻¹ in 2005. On the other hand in Tamale and Tolon-Kumbungu districts, grain production increased from 2003 to 2004 and decreased in 2005. This trend could be attributed to the poor rainfall pattern in the two districts compared to Bawku district. The relatively high production in Bawku district could be attributed to the reduction in stiga infestation as a result of the effect of rotation with soybean. The grain production pattern over the study period STR maize was similar to that of the farmers’ variety. The difference was that the STR maize produced more grain at each of the districts than the farmers’ variety. The STR maize grown in sole cropping system produced up to 70% more grain than the farmers’ variety grown under similar conditions.

CONCLUSIONS AND RECOMMENDATIONS

The goal of this study are to ensure food security by promoting the growing of STR maize varieties in intercropping or rotating with trap crops (e.g., TGX 1442-2E) in stiga endemic locations of North
Eastern Ghana where *Striga hermonthica* is a very serious parasitic weed on maize. Three striga tolerant/resistant maize varieties, ACR 94 TZE Comp 5-W, ACR 97 TZL Comp 1-W and IWD STR C1, were grown in rotation and in intercropping with soybean from 2002 to 2005 on farmers’ fields. Striga incidence was recorded as the number of striga plants at 10 and 12 weeks after planting, visible effects due to striga such as leaf chlorosis, stunting and maize grain yield. The results showed that the STR varieties grown in sole cropping supported few striga plants and produced up to 60 % more grain than the farmers’ variety grown under similar conditions. The maize grown under intercropping supported fewer striga plants as compared to those grown in sole cropping due to the reduced plant stand as well as the effect due to the soybean. There was a reduction of 89% emerged striga plants when STR maize was rotated with soybean from 2003 to 2005 compared to 17.4 % when grown in intercropping system. Therefore, the growing of STR varieties in rotation with soybean may be one of the best and practical method of controlling *Striga hermonthica* on farmers’ fields.

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REFERENCES


