**Striga Management Practices in Maize Farming: A regional Survey of Farmers Perceptions, Approaches and Challenges**

**ABSTRACT**

A survey was conducted in 2024 with 250 farmers in 25 parishes of five districts namely; Iganga (IG), Bugweri (BW), Luuka (LU), Namutumba (NM) and Bugiri (BG) in Uganda to assess the farmers’ perception of the impact of Striga *hermonthica* infestation on crop production and the current management strategies. Data was collected using a questionnaire by random sampling from a stratified random sample of 250 farmers to capture the diverse farming households. Data collected was analyzed by cohort analysis. The total number of males (132 farmers) were more than the females (118 farmers) in all the samples. Majority of interviewed farmers had gone to school and the highest numbers of farmers who had no education were in BW (14%) and LU (12%) districts. Many farmers (54%) in IG & BW (36%) districts had farming experience of more than 21 years and IG district had lower (14%) number with farming experience of 11-12 years. A higher number (18%) of farmers with less than 5 years’ experience were in NM district. The major crops in all districts were maize (100%), cassava (75%), sweet potatoes (51%) and groundnuts(70%) was grown only in BW, LU, NA & BG while, beans (84%) was a major crop in IG district*. S. hermonthica* was well known to all farmers (100%) and high severity levels were reported in LU,and NM and by key informants (90%) and similarly in BW (88%), BG (86%) and IG (84%) districts. Striga control methods adopted included hand pulling/rouging (82%), crop rotation (78%), deep ploughing (67%), fertilizer/manure (62%), Intercropping (37%), continuous/frequent weeding (22%) and herbicides (17%) and 4% of the farmers were not controlling Striga weeds. Striga control adoption rates were high in IG (78-92%), LU (64-90%), NM (73-86%) and BG (56-84%) districts and low in BW (40-60%) district. The positive trends in the use of the *Striga* control technologies were 92%, 73% ,85%, 73% and 46% for the districts respectively and the percent farmers controlling *Striga* was high in IG (47%), BW (37%), LU and BG(34%) but low in NM (27%) district. Maize ranked most popular followed by cassava, sweet potatoes, groundnuts and beans in a descending order and the reasons for the ranks included food security, market demand, easy to cultivate, soil health improvement, crop rotation and resilience. The most popular methods for *Striga* control were hand pulling/ hoeing (82%), crop rotation (78%), deep ploughing (67%), manures/ organic fertilisers (62%), intercropping (37%), frequent weeding (22%) and herbicides (17%). Source of *Striga* control methods included fellow farmers (52%), extension staff (23%), family members (13%) and self initiative (12%). The advantages, disadvantages, accessibility, effectiveness and labor intensity of Striga control methods were evaluated. Declines in maize yield were reported in IG (80%), BW (75%) and BG (58%) districts with the average maize grain yield of 1.3 – 5.0 Mt ha-1 with 3.0 - 5.0 & 1.8-2.0 Mt ha-1 for IG and BG districts respectively. The majority of respondents (55-65%) had received some trainings on Striga control from Extension workers or non government organization under crop rotation, hand pulling of Striga + burning, use of inorganic fertilizers, improved seeds, use of 2-4 D herbicides, intercropping, deep ploughing and frequent weeding. Based on the findings *S. hermonthica* is a serious problem in Uganda and farmers have made efforts to control it using various methods. There is need to deliberately conduct more farmer training for Extension workers and farmers especially for the youths in order to contain its negative effects on maize yields in Eastern Uganda.

**Key words:** Farming experience,Food security, Intercropping, Pest control, Severity

**1.INTRODUCTION**

Striga *hermonthica* is a pest in many agroecologies and the primary biological constraint to the production of cereal crops namely; maize, rice, millet and sorghum. [1] and [2] have reported *S. hermonthica* to cause crop yield losses of up to 100%. *S. hermonthinca* is a parasitic weed that causes an estimated 7-10 billion USD losses across sub-saharan Africa (SSA) annually in crop productivity [3] and food scarcity to 100 million people [4] &;[5].. Striga belongs to the family *Orobanchaceae* and can not survive on its own without a host. It depends solely on its host plant for nutrients, growth and photosynthesizes (hemiparasite). Its growth pattern, is complex and closely associated with its host and results into substantial damage like chlorosis, thin stalk, reduced height and total crop losses [6]. A single Striga plant can produce up to 500,000 seeds capable of remaining viable in the soil for 20 years and adaptability of the pest to a wide range of hosts and environmental conditions has made it one of the widespread and sussessful parasitic plants [7].The above attributes contribute to the control of StrigaSpp. being difficult. [8]. The life cycle of Striga Spp. involves germination, host attachment, haustoria formation/ penetration, vascular connections, nutrient absorption, flowering and production of seeds. The seeds germinate only in the presence of a host derived chemical signal called Strigalactone and germinaton is pre conditioned by warm and moist conditions [9]. Yacoubou *et al.*, (2021) [3] observed that Strigaspp. complete their life cycle in 10 weeks, normally after the host plant has been harvested. Maize *(Zea mays* L.) is a perennial crop that belongs to the family *Poaceae/ Gramineae* [10]. It is produced globally and one of the top three important cereals after wheat and rice in the world. Maize is cultivated on over 40 million hectares in SSA countries and constitutes more than 25% of daily caloric intake in both southern and eastern Africa [11]. It is a major food security crop in SSA [12] and the most highly grown crop for food security in eastern Uganda [13] but currently most affected by *S. hermonthica*.[5] reported that over 50 million hectares of cultivatable land under cereals have been infested by Striga spp. Maize is similarly a staple food in Uganda, feed for livestock and a means of livelihood and food security for about 75% of the Ugandan population [13].. Maize is also used in the food industry, paints, papers, biodiesel, textiles and adhesives [14].Small holder farmers in Uganda perceive the severity of *S. hermonthica* which is the predominant species as very high and as a witch weed responsible for their increased food insecurity and poor livelihoods.

Several methods have been used to combat this parastic weed. The cultural practices include hand pulling, crop rotation, intercropping, trap or catch crops and soil fertility (Nitrogen) improvement. Chemical methods like use of imazapyr, resistant crop varieties, suicidal germination and biological control agents such as fungi and bacteria have been attempted [15]. None of these methods have been able to eradicate the incidence of *S.hermonthica* alone, but integrated approaches of using two or more practices have proven effective in reducing Striga [16]. The detrimental effects of chemicals has led to research in use of allelopathic compounds which have no adverse effects and control the noxious weed [17]. Integrated management of Striga has caused significant output [16] with less negative effects but the farmers willingness and commitment are vital for the effective control of Striga*..*There is need for further research on integrated strategies to control Striga. The adoption of Striga management strategies is dependant upon the accessibility of resources, skills, technical know how, time and labor among subsistence farmers. Removing Striga weeds by hand is the most affordable cultural control method but it is lengthy, and less efficient in mitigating crop damage [18]. Chemical control is quite expensive and lacks clear protocols and the formulations are not simple to utilize. The use of soil micro organisms like bacteria and fungi has been adopted to reduce the adverse effects of chemicals but have not recorded corresponding increase in yield [19]. A survey was therefore conducted during 2024 with 250 farmers in in 25 parishes of five districts with a goal of assessing the farmers’ perception of the impact of Striga Spp. infestation on crop production in eastern Uganda and their current management strategies. The specific objectives considered were to evaluate the farmers’ awareness and understanding of Strigaweeds infestation and its effects on crop yields and to identify the different methods and practices used by farmers to manage and control Strigaweedsin cereal crops.The other objectives included assessing farmers’ perceptions of the effectiveness and challenges of current Strigacontrol methods in the region and understanding the impact of Striga infestations on farmers’ livelihoods and overall community welfare.

**METHODOLOGY**

**2.1 Attributes for Data collection**

Data was collected by questionnaire on background information, major crops grown, knowledge about *S. hermonthica* weeds, ranking of major crops and *S. hermonthica,* control practices. The questionnaire also documented data on sources of control technologies, effects of the Striga weed on maize yield and training conducted on *S. hermonthica* weed control. The survey was conducted in 25 parishes selected from 5 districts where cereals that are host plants for *S. hermonthica,* are grown.

**2.2 Sampling**

2.2.1 Stratified sampling

The population was stratified into small (3-5 acres), medium (6-10 acres) and large (over 10 acres) farmers to capture variability based of farm size. It was assumed that large scale farmers had more experience on *S. hermonthica* with a higher variety of crops than small scale farmers

2.2.2 Random sampling

From each of the 25 selected parishes, a random sample of 10 farmers was taken as the selected population sample to ensue diverse farming households

**2.3 Data collection**

2.3.1 Questionnaire survey

Structured questionnaires were used to gather both qualitative and quantitative data from the stratified population. The questions covered areas in section 2.1 above.

2.3.2 Key informant Interviews

Interviews with experts like agricultural extension officers and other stakeholders provided additional information.

2.3.3 Ethical considerations

The purpose of the survey was communicated to the respondents who agreed to participate voluntarily with confidentiality

**2.4 Data analysis**

The collected data were analyzed by cohort analysis. Farmer’s age, education, experience in farming, maize yield trends and percent farmer trained were analyzed using time based cohorts, while knowledge and experience about Striga were analyzed by identify patterns and insights. The data on major crops, Striga control technologies and quality attributes of the major Striga control technologies were analyzed by ranking method.

**3.0 RESULTS**

**3.1 Background information**

3.1.1 Gender

In all the 5 districts namely; Iganga, Bugweri, Luuka, Namutumba and Bugiri the total number of males (132 farmers) were more than the females (118 farmers) as indicated in Table 1.

3.1.2 Age group

Data on the age groups of respondents in the 5 districts is indicated in Table 1. The number of farmer respondents differed from the age groups of 18-30 years (61 farmers), 31-45 years (93 farmers), 46-60 years (76 farmers) and only 20 farmers were above 61 years in all the 5 districts. Namutumba and Bugiri districts recorded no females aged above 61 years and all the key informants were above 30 years of age.

3.1.3 Education level

The data on Education levels is indicated in Table 1. The majority of interviewed farmers had gone to school and only Iganga district recorded no females that had received tertiary education. Namutumba and Bugiri districts recorded similar higher numbers (16%) of farmers with tertiary education. Similarly higher numbers of farmers who acquired secondary education were found in Namutumba (46%) and Bugiri (42%) districts. The highest numbers of farmers who had no education were found in Bugweri (14%) and Luuka (12%) districts.

Table 1 Gender, age groups, education levels and experience in farming for farmers

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| District | Gender | | Age group | | | | | | | | Education level | | | | | | | | Years of farming | | | |
|  | M | F | 18-30 | | 31-45 | | 46-60 | | 61+ | | None | | Primary | | Secondary | | Tertiary | | <5 | 6-10 | 11-20 | 21+ |
|  |  |  | M | F | M | F | M | F | M | F | M | F | M | F | M | F | M | F | T | T | T | T |
| Iganga | 28 | 22 | 8 | 2 | 12 | 8 | 5 | 10 | 3 | 2 | 1 | 4 | 11 | 13 | 10 | 8 | 3 | 0 | 6 | 10 | 7 | 27 |
| Bugweri | 30 | 20 | 9 | 3 | 9 | 6 | 8 | 8 | 4 | 3 | 2 | 5 | 13 | 5 | 10 | 8 | 5 | 2 | 3 | 16 | 13 | 18 |
| Luuka | 23 | 27 | 8 | 4 | 13 | 6 | 7 | 7 | 3 | 2 | 2 | 4 | 12 | 10 | 11 | 5 | 4 | 2 | 4 | 15 | 18 | 13 |
| Namutumba | 25 | 25 | 6 | 9 | 11 | 9 | 6 | 8 | 1 | 0 | 1 | 1 | 8 | 9 | 10 | 13 | 4 | 4 | 9 | 21 | 13 | 7 |
| Bugiri | 32 | 18 | 7 | 5 | 12 | 7 | 10 | 7 | 2 | 0 | 1 | 3 | 10 | 7 | 12 | 9 | 4 | 4 | 5 | 18 | 8 | 19 |
| *Key informants* | 12 | 4 | 0 | 0 | 5 | 3 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 6 | 0 | 0 | 4 | 12 |

T= Total number of males and females

3.1.4 Experience in farming

A high number of farmers (54%) with farming experience of more than 21 years, were in Iganga followed by Bugweri (36%) district (Table 1). Iganga had lower (14%) farmers with farming experience of 11-12 years and a higher number of farmers (18%) with less than 5 years’ experience were recorded in Namutumba district.

**3.2 Major crops grown and level of knowledge about Striga *hermonthica***

3.2.1 Major crops

The major crops grown in all the districts were maize (100%), cassava (75%) and sweet potatoes (51%) (Table 2). Groundnuts crop (70%) was grown in only 4 districts of Bugweri, Luuka, Namutumba and Bugiri while beans (84%) were a major crop in Iganga district.

3.2.2 Knowledge aboutStriga *hermonthica*

1. *hermonthica* was reported to be known to all farmers (100%) in the 5 districts (Table 2)

3.2.3 Level of severity of *S. hermonthica*

The results onStrigaseverity per square metre is indicated in Table 2. The severity levels were indicated as medium to high by 90% of the farmers in the districts of Luuka and Namutumba. This was similar to the response (90%) from key informants. The severities reported were lower in Bugweri (88%), Bugiri (86%) and Iganga (84%) districts.

3.2.4 Methods used to control *S.hermonthica*

The data on the percent number of farmers who use a particular method or combination of methods is indicated in Table 2. The major control methods are hand pulling/rouging (82%), crop rotation (78%), deep ploughing (67%) and fertilizer/manure application (62%). Intercropping maize with legumes (37%), continuous/frequent weeding (22%) and use of herbicides (17%) were the least adopted technologies for Striga weed control in the 5 districts. Only 4% of the farmers in the 5 districts indicated that they were not controlling Striga weeds in anyway. Iganga (78-92%) and Luuka (64-90%) districts farmers indicated higher adoptions of the Striga weed control technologies followed by farmers in Namutumba (73-86%) and Bugiri (56-84%) districts and lower adoption levels (40-60%) were recorded in Bugweri district for the control technologies adopted.

3.2.5 Trends in using the different S. hermonthica control Technologies

The trends in controlling Striga in the different districts are indicated in Table 2. High trends were recorded for Iganga (92%), Namutumba (85%), Bugiri (73%) and Luuka (72%). Bugweri scored a lower (46%) positive trend in the use of the Striga control technologies amongst the districts. The percent number of farmers controlling Striga was reported high in Iganga (47%), followed by Bugweri (37%), Luuka and Bugiri (34%) and low in Namutumba (27%).

3.2.6 Number of farmers controlling Striga *hermonthica*

Table 2 Major crops grown, level of knowledge about Striga/ severity, number of farmers controlling Striga and trend of the control measures

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| District | Major crops (%) | Knowledge about Striga (%) | | Level of severity by Striga as count m-2 (%) | | | Methods used to control Striga in combination (%) | | | | | | | | Trend in using Striga control methods (%) | | Number of farmers controlling Striga (%) | | |
|  |  | Yes | No | Low  (<10) | Mod (10-20) | High  (20+) | P | R | D | F | I | C | H | N | Increase | Decline | Few | Mod | Many |
| Bugiri | Maize (100)  G/nuts (50)  Cassava (82)  S/Potatoes (38) | 100 | 0 | 14 | 26 | 60 | 84 | 72 | 82 | 56 | 42 | 18 | 12 | 5 | 73 | 27 | 23 | 38 | 34 |
| Bugweri | Maize (100)  G/nuts (70)  Cassava (74)  S/Potatoes (42) | 100 | 0 | 12 | 54 | 34 | 60 | 56 | 42 | 40 | 36 | 28 | 24 | 3 | 76 | 24 | 20 | 40 | 37 |
| Iganga | Maize (96)  Beans (84)  Cassava (72)  S/Potatoes (60) | 100 | 0 | 16 | 22 | 62 | 92 | 90 | 74 | 78 | 36 | 20 | 16 | 3 | 92 | 8 | 8 | 32 | 47 |
| Luuka | Maize (100)  G/nuts (80)  Cassava (62)  S/Potatoes (51) | 100 | 0 | 10 | 26 | 64 | 90 | 82 | 58 | 64 | 38 | 24 | 15 | 6 | 72 | 28 | 18 | 42 | 34 |
| Namutumba | Maize (100)  G/nuts (80)  Cassava (84)  S/Potatoes (62) | 100 | 0 | 10 | 34 | 56 | 86 | 88 | 78 | 73 | 34 | 21 | 18 | 4 | 85 | 15 | 24 | 45 | 27 |
| Key Informants | Maize  Cassava  S/ Potatoes  G/nuts | 100 | 0 | 10 | 20 | 70 | 90 | 82 | 45 | 50 | 38 | 30 | 12 | 8 | 50 | 50 | 50 | 30 | 20 |

Mod = Moderate, P=Hand pulling/ Rouging, R= Crop Rotation, F= Fertilizer/ manure, D = Deep ploughing with oxen, I= Intercropping maize with legumes, C=Continuous/ frequent weeding, H= Herbicides, N=None

The data on number of farmers controlling *S, hermonthica* weed is indicated in Table 2. In all districts moderate to high (79%) numbers of farmers were reported to control Strigaweed with Iganga (79%) leading followed by Bugweri (77%), Luuka (76%), Namutumba (72%) and Bugiri (72%) at par.

**3.3. Ranking of crops by farmers in the districts and reasons for the ranks**

The data on ranking and reasons for the ranking of the 4 major crops in the districts is indicated in Table 3. The ranking was based on the profitability, market demand, ease of cultivation, climate suitability, risk and resilience, storage/ shelf life, crop rotation / soil health, labor requirements and yield. The most popular crop was ranked number 1 and the least number 4 in descending order. Maize crop was ranked as the most popular crop in the region followed by cassava, sweet potatoes, groundnuts and beans in a descending order. The main reasons given by the farmers for the rankings were food security, market demand easy to cultivate, improvement of soil health, crop rotation and risk/ resilience’

Table 3. Crop priority ranking by farmers in Bugiri, Bugweri, Iganga, Luuka and Namutumba Districts of Eastern Uganda (1 as highest & 4 being lowest).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Crop | Bugiri | Bugweri | Iganga | Luuka | Namutumba | Key Informants | Reasons for ranking |
| Maize | 1 | 1 | 1 | 1 | 1 | 1 | Food security market demand, easy to cultivate |
| Cassava | 2 | 3 | 3 | 2 | 4 | 2 | Food security, market demand, risk/ resilience |
| Sweet potatoes | 3 | 2 | 4 | 3 | 3 | 3 | Food security market demand, easy to cultivate |
| Groundnuts | 4 | 4 | - | 4 | 2 | 4 | Food security, risk. resilience & improves soil health |
| Beans | - | - | 2 | - | - | - | Food security, ease of cultivation, crop rotation, improves soil health |

3.4 Ranking of *S. hermonthica* Control technologies by farmers

Table 4 shows the ranking of technology use by farmers to control *S. hermonthica* weed. Hand pulling/ hoeing was ranked as the most popular method (82%) followed by crop rotation with non host plants to the noxious parasitic weed (78%). The practice of deep ploughing of Striga into the soil was ranked less popular (67%) with the application of manures and organic fertilisers as less commonly adopted (62%) by farmers in the 5 districts. The other less frequently used methods included intercropping maize with legumes (37%), continuous/frequent weeding (22%) and use of herbicides (17%). About 4% of the farmers in the 5 districts did not control *S, hermonthica*.

Table 4 Striga control technologies ranking by farmers of Bugiri, Bugweri, Iganga, Luuka and Namutumba Districts in Eastern Uganda (1 = Most popular & 7 = Least popular).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Ranking by farmers in the districts (1-7) | | | | | |
| Striga control technologies adopted by farmers | Farmers in Districts using method besides other methods (%) | Bugiri | Bugweri | Iganga | Luuka | Namutumba | Key Informants |
| Hand pulling/ hoeing | 82 | 1 | 1 | 1 | 1 | 1 | 1 |
| Crop Rotation with Striga non hosts plants | 78 | 2 | 2 | 3 | 2 | 3 | 2 |
| Deep ploughing | 67 | 3 | 3 | 2 | 3 | 2 | 3 |
| Inorganic Fertiliser / organic manures | 62 | 4 | 4 | 4 | 4 | 4 | 4 |
| Intercropping maize + legumes | 37 | 5 | 5 | 5 | 5 | 5 | 5 |
| Continous / frequent weeding | 22 | 6 | 6 | 6 | 6 | 6 | 6 |
| Herbicides | 17 | 7 | 7 | 7 | 7 | 7 | 7 |
| None | 4 |  |  |  |  |  |  |

3.5 Sources, benefits, strengths, efficacy and accessibility of the major Striga control technologies

The sources of the technologies, strength and quality attributes of the control technologies for Striga weeds are indicated in Table 5.

Table 5 Sources, strengths and quality attributes of the major Striga control technologies in the districts of Bugiri, Bugweri, Iganga, Luuka and Namutumba in Eastern Uganda

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sources of Striga control technologies (%) | Striga control method | Advantages of control method | Disadvantages of control method | Labor intensity | Effectiveness | Availability |
| Farmers (52%)  Extension staff (23%)  Family/parents (13%)  Self initiative (12%) | Hand pulling | i)Reduces weed seed bank & population if done early  ii)Reduces competition between crops + weeds | i) Tedious  ii)Expensive  iii)Weeds break  iv)Spreads seeds if done late | High | High | High |
| Crop Rotation with non hosts | i)Reduces Striga seed bank  ii)Promotes growth of non host plants for Striga  iii)Improves soil fertility  iv)Reduces pests & diseases | i)Incompatible crops in some soils under rotation  ii)Limited land  iii)Requires extra skills  iv)Shortage of seed for sequential crops | High | High | High |
| Inorganic Fertiliser / | Improved crop growth | Expensive | Low | High | Low |
| Deep ploughing | i)Reduces weed density  ii)Improves crop growth  iii) Burriy weed seeds deep in soil | i)Expensive  ii) Rough seed beds  iii)Propagate Striga seeds  iv)Difficult in mixed cropping | High | Low | Low |

3.5.1 Sources of Striga control technologies

The major source of Striga control method was reported as fellow farmers (52%) followed by extension staff (23%) and family members and parents (13%). Farmers also expressed self initiative (12%) as a source method by which they coped up with *S. hermonthica* pandemic.

3.5.2 Strengths of Striga control methods

The advantages of the different Striga control methods expressed by the farmers were majorly to reduce the weed population and seed bank, reduce the crop/weed competition for soil nutrients, promotion of the non host plants, improve soil health and crop growth, reduce pest and disease infestations. The disadvantages reported by farmers included high costs and labor intensity and hard to pull the weeds that cause more weed sprouts under hand pulling, incompatible crop rotations and mixtures that require extra skills and more land and seed.

3.5.3 Quality attributes of the Striga control methods

Hand pulling of weeds and crop rotations with Striga non-host plants were reported as common methods since they were easily accessible, relatively effective though labor intensive. The use of inorganic fertilisers and organic manure technologies was considered not readily accessible though effective and not labor intensive. Deep ploughing of Striga weeds was reported to be labor intensive, not effective in weed control and labor to do it is not readily available.

3.6 Effects of Striga on maize yield and types of farmer trainings

The effects of *S. hermonthica* on maize yield and trainings conducted by extension staff are indicated in Table 6.

3..6.1 Maize yield in past 5 years

The majority of respondents in the survey reported an increased (73%) reduction in maize yield in the past 5 years. The respondents who did not recognize any changes in the trend of maize yield was 27% in the whole region. There was no body who reported an increase in the yields of maize in the past 5 years. The highest decline (80%) in maize yield was reported in Iganda followed by Bugweri (75%) and lowest in Bugiri (58%) district, All the key informants (100%) reported decline in maize yields. The average maize grain yield reported by farmers in the 5 districts was 1.3 – 5.0 Mt per hectare with high yield (3.0-5.0 Mt ha-1) reported from Iganga and lower in Bugiri (1.8-2.0 Mt ha-1)) district. Male farmers reported higher maize yield (2.5 – 5.0 Mt ha-1) than female farmer (1.3-3.0 Mt ha-1).

Table 6 Effects of Striga on maize yield and types of farmer trainings

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| District | Percent change in Yield of maize in past 5 years | | | Percent farmers trained in Striga control during past 5 years | | Subjects of farmers training | Average Yield of maize (Mt ha-1) | |
|  | Increase | Decrease | None | Yes | No |  | Male | Female |
| Iganga | 0 | 80 | 20 | 60 | 40 | 1. Crop rotation   ii) Hand pulling of Striga and burning  iii) Inorganic fertiliser use  iv) Improved seeds / IR maize  v) Use of 2-4 D Herbicides  vi) Intercropping maize with legumes  vii) Deep ploughing  viii) Frequent weeding | 5.0 | 3.0 |
| Bugweri | 0 | 75 | 25 | 60 | 40 | 4.0 | 3.0 |
| Luuka | 0 | 67 | 33 | 70 | 30 | 3.0 | 2.0 |
| Namutumba | 0 | 60 | 40 | 55 | 45 | 2.5 | 1.3 |
| Bugiri | 0 | 58 | 42 | 65 | 35 | 2.0 | 1.8 |
| Key Informants | 0 | 100 | 0 | 10 | 90 | 3.5 | 3.4 |

3.6.2 Farmers trained in Striga control

The majority of respondents (55-65%) had received some trainings on Striga control from Extension workers or non government organization in the past 5 years. The farmers were trained in various Striga control technologies that included: crop rotation, hand pulling of Striga + burning, use of inorganic fertilisers and improved seeds/IR maize, weed control using 2-4 D herbicides, intercropping maize with legumes, deep ploughing and frequent weeding. The highest number of trainings were in Luuka and least in Namutumba districts.

1. **DISCUSSION**

**4.1 Gender and Age group**

More males (53%) than females (47%) were respondents to the interview. This is attributed to cultural norms. In many regions, farming is traditionally viewed as a male dominated occupation and men are the decision makers leaving the women to take on on domestic roles. This cultural expectation limits women’s involvement in formal agricultural activities. Men often have greater access to resources like land, financing and networks that support their participation in agricultural activities. In contrast women face barriers like access to limited land or credit, restricting their opportunities to participate in agricultural activities. Women particularly in rural areas, often have multiple responsibilities, such as household chores, childcare which limit their availability to data collection and training especially if they are scheduled at times that conflict with these duties. Lack of empowerment could have contributed to less participation by women in the interview as they often don’t have the same level of confidence to participate in rural programs or may not be aware of opportunities. Addressing these issues requires creating inclusive policies and providing targeted support to ensure that women have equal access to agricultural training and resources. The results are similar to that of a survey by [20] who observed more males (59.6%) participants in a survey than females (40.4%) but the majority (74%) were between 20 - 35 years. The youths (18 - 30 years) constituted about 25% of the respondents, with the majority of farmers (68%) in the age bracket of 31-60 years). The low percentage of youth farmers could reduce adoption of sustainable practices / technologies, entrepreneurship, community engagement, leadership and advocacy and reduce innovations in farming practices, resulting into low productivity and increased environmental footprints of agriculture. The low percentage of youths could be ascribed to minimal youth involvement by the local governments in agricultural activities and shared understanding of their roles in agricultural growth. [21] reported that the youths have pessimistic perceptions about agriculture’s capability of improving their living standards. Similarly [22] reported thatyouths have a belief that work in Agriculture does not provide any opportunities for self realisation The low number of elderly above 61 tears (8%) signified lack of farmers with decades of experience and traditional knowledge about farming techniques and management of biotic nd abiotic stresses including *S, hermonthica.* While some older farmers may initially be resistant to change, many adapt to new agricultural technologies particularly those that lead to improved yields.like Striga control methods.

The absence of female farmers aged 61 years and over in Namutumba and Bugiri districts implies that some indigenous knowledge passed down through generations, about suitable farming practices by female farmers such as local ecological systems and crop management could be lost making it harder to maintain traditional farming methods and relying on external less sustainable, agricultural tecchniques. Elderly women often play important roles in maintaining social structures, offering mentorship to young farmers and helping with community cohesion. Their absence in Namutuba and Bugiri districta ould lead to breakdown in these social roles, reducing intergenerational knowledge transfer and weakening community bonds. Food security could also be jeopardized especially if the young generations are less willing to take up farming or lack the required experience. The absence of elderly women in farming could deepen gender disparities, as young women might be pushed out of the agriculture due to changing gender roles or less access to resources, training and land. Women play an important role in growing specific crops or preparing food in ways tied to cultural identity. Absence of the elderly women may result in the erosion of cultural heritage linked to agriculture. More participants were in age group 31-45 (37%) than 46-50 years (31%), 18-30 years (24%) and over 61 years (8%). This could be attributed to the peak productivity in that age bracket. They typically have the energy, physical capability and experience to manage the demands of farming. This age group is likely to have acquired farming skills, resources, financial stability and confidence, allowing them to manage the complexities of agricultural work effectively. The age bracket also has experience and knowledge that will have accumulated over time sufficiently and can deal with farming challenges like could be asked in an interview than younger or older individuals who may have retired from farming or shifted to other activities. The 31-45 years age group is also likely to embrace new technologies, balancing tradition with innovation unlike younger and older farmers who may be less inclined to change established practices. This age group may be taking over farms or establishing their own, bridging the gap between the young and elderly. Overall the 31-45 age group is the most active participants in farming.

**4.2 Education level**

The high numbers (16%) of farmers with tertiary education in Namutumba and Bugiri and more farmers with secondary education in Namutumba (46%) and Bugiri (42%) districts implied that the farmers in these districts were more equipped with modern farming technologies and best practices. Education allows them to improve productivity, adopt sustainable practices like Striga weed control and manage their farm operations and best practices. Education also enhances their ability to access and apply research and innovations in agriculture. The absence of women farmers with tertiary education in Iganga district and high numbers of uneducated farmers in Bugweri (14%) and Luuka (12%) districts implied that women farmers in Iganga and farmers in Bugweri and Luuka district are more likely not to access financial resources, technologies, government programs and subsidies. The farmers in the three districts are less likely to efficiently manage finances, plan and run their farms as profitable businesses since they may not secure loans or market their produce. Higher education also enhances problem solving and decision making on pest (Striga *spp*) and disease (Fall Army worm) out breaks, climate change effects and fluctuating prices. Farmers with high education may have better communication and networking kills, allowing them to engage more effectively in agricultural markets, cooperatives and industry associations for better prices and increased participation in value chains. Farmers with high education may explore alternative activities like agro-tourism and value addition to supplement their income and reduce risks. It is important to note that education alone does not always guarantee greater participation in farming. Other factors like access to land, financial resources and local agricultural context can play significant roles in shaping a farmer’s involvement in the sector. In some cases less educated farmers may rely on traditional knowledge and experience which can also be highly effective. [23] reported that education affects technology adoption and use depending on the type of technology.

**4.3 Experience in farming**

The survey revealed a high number of experienced farmers in Iganga (54%) and Bugweri (36%) districts coupled low number of farmers (14%) with 11-12 years of farming experience in Iganga and a high number of farmers (18%) with less than 5 years’ experience were found in Namutumba district. The data implied that Iganga and Bugweri districts had farmers with a wealth of knowledge gained from years of trial and error, successes and failures. This allows them to make better decisions about crop selection, planting times, simple irrigation, pest and disease management, soil fertility management and marketing strategies than farmers in the other districts. Experienced farmers draw on their prior knowledge and adapt to changing circumstances. They are better at managing their resources such as land, labor, water and fertilizers for maximum output, sustainability and improved productivity. The experienced farmers are better at budgeting, record keeping, and labor management. They understand better market trends, pricing and consumer demands. These farmers are consulted for guidance by younger or less experienced farmers and that valuable knowledge is passed on to the whole community. However, while experience offers numerous advantages, it is also important for farmers to stay open to new ideas, technologies and methods. Farming practices evolve and the ability to combine experience with innovations is key to continued success. [24] found that the key factors influencing the decisions of youths to participate in agriculture extensively include the number of years of farming experience, access to credit, membership in social groups, income and land access.

**4.3 Major crops grown**

The crops grown by farmers were maize (100%), cassava (75%) and sweet potatoes (51%) across the 5 districts. Adoption of crops by farmers in a particular area is influenced by several factors, both internal (specific to the farmer) and external (related to the environment, market and policies), The adoption of maize as the major crop and a host plant to *S. hermonthica* weed in the 5 districts could be attributed to suitability of maize to the local environment and soil conditions. Maize crop offers relatively high net profits with low production costs and readily available inputs. The crop has ready market though susceptible to Strigaweeds and Fall army worm (FAW). However, the increased risks with the latter has created a lot of uncertainty with growing the maize crop. The availability of quality maize seed, fertilizers, pesticides could have supported the adoption of maize in Eastern Uganda. Traditional farming practices, cultural preferences and community norms possibly influence the adoption of cassava and sweet potatoes. Peer influence, local knowledge, low labor costs, sharing of best practices within the farming communities, access to agricultural extension services may have caused higher adoptions of the three crops. The long experience of farmers in growing a crop successfully over years makes a farmer continue growing the crop. Crop adoption is a complex decision making process that considers both practical and socio-economic factors. Bugweri, Luuka, Namutumba and Bugiri farmers grew groundnuts (70%) as a second major crop (Table 2) possibly because of its profitability and suitability to the ecological zone. Groundnuts has been reported as an intercrop with highest synergy and recommended in the maize based cropping systems in Uganda by [25: *In press*]. The legume crop is a good false host that stimulates suicidal germination of Striga weeds, depletes the seed bank and improves soil fertility [26]. The adoption of groundnuts may be associated with experiences of the farmers in pest management of *S, hermonthica* that has enabled them to make better decisions about crop selection, planting times, pest and disease management. Beans were a major crop (84%) only in Iganga district possibly for similar reasons and possible ready market for the urban district.

**4.4 Knowledge and level of severity of *S. hermonthica***

All the farmers knew Striga *hermonthica* weed. This is associated with the significant damage the weed has on crops in yield and quality reductions. Identifying Striga weed helps farmers to take proactive measures to protect their crops, minimize losses and ensure long term productivity, while promoting sustainable and economic viable farming practices. A high severity level of more than 20 Striga weeds m-2 was reported by the majority (55%) of farmers, 32.% indicated moderate (10-20 Striga m-2) and only 12% expressed a low levels of severity for the parasitic weed. The severity levels imply reduction in the cereal crops yields and lower incomes. Farmers may need to spend more on pest control measures such as pesticides, labor intensive methods etc. The lost revenue can be a financial burden. The high severity also affects crop quality eg. shrinkled maize grains making it less marketable. Excessive use of chemical for Striga weed control may have adverse effects on the environment (soil contamination, harm to beneficial insects) and human health (exposure to workers).This can create long term sustainability challenges for farming practices. [27] reported that pesticides can cause acute toxicity if a high dose is inhaled, ingested or comes into contact with the skin or eyes while prolonged exposure to pesticides lead to chronic carcinogenicity, teratogenicity and endocrine disruption. The scientists also reported soil, food, air and water contamination besides effects on the ecosystems by pesticides.

**4.5 Methods to control *S.hermonthica.***

The *S. hermonthica*  weed control methods and adopted levels by farmers in the 5 districts included hand pulling/ rouging (82%), crop rotation (78%), deep ploughing (67%) fertilizer/manure application (62%), intercropping maize with legumes (37%), continuous/frequent weeding (22%) and use of herbicides (17%). About 4% of the farmers in the 5 districts did not control *S, hermonthica*. The adopted methods have limitations. The physical control (manual removal) that was reported adopted by the majority of farmers is labor intensive, time consuming and not always practical. The cultural control (crop rotation and intercropping) have limited impact as the methods alone might not completely eradicate Striga weeds, especially in heavily infested areas. The method is labor intensive, as proper crop rotation or intercropping requires careful planning and additional labor. Some crops may not be suitable for rotation or intercropping with Striga resistant crops and the method takes several years to show significant improvements. The use of chemicals (herbicides) is associated with high costs for the smallholder farmers and can lead to soil and water contamination. Striga can also develop resistance to certain herbicides and chemicals may harm the main crops. Soil fertility management (Ferlilizers and organic matter) have the limitations of high costs, limited effectiveness and over reliance on chemical fertilizers can lead to soil degradation over time. Striga trap crops like cowpeas and groundnuts may be used to attract and kill Striga weeds. The crops however require additional land and resources that small holders may not afford and may not control Striga Spp, in areas with heavy infestations and some trap crops may not be adapted to areas where Striga weed is a problem. The use of Biological control (Striga resistant crops or natural enemies) was not reported in the survey but where practiced, is limited by the slow process of developing the resistant crop varieties and genetic development of the resistant varieties is still a challengewhereas biological control may not be effective across all environments and requires specific conditions. While each method has its strengths, Striga control often requires an integrated approach combining several methods to be effective, Research work conducted on Striga weed control by [26] indicates trap cropping or growing of false hosts such as cowpeas, groundnuts, simsim and cotton stimulates suicidal germination and improves soil fertility were reported to deplete the seed bank Combining trap crops and nitrogen fertilizers was also reported to significantly decrease Striga seed bank [28]. meanwhile, cover cropping of the soil or mulching was reported to reduce the Striga seed bank [29]. Intercropping cereals with legumes also reduced Striga weeds emergence by improving soil fertility, organic matter and soil moisture content and releasing allelochemicals such as isoflavanoides, phenolics and terpenoids which might impact Striga germination, growth and development [30] & [31]. A combination of herbicide resistant maize varieties intercropped with legumes appeared more effective against Striga [32]. There is therefore need to train farmers in integrated approaches to manage the Striga weed problem.

**4.6 Adoptions of different technologies and trends in controlling *S.hermonthica.***

The high adoption levels for Striga in Iganga (78-92%), Namutumba (73-86%), Bugiri (56-84%), Luuka (64-90%) and Bugweri (40-60). The trends in *S. hermonthica* control reported was highest in Iganga (92%), and lowest in Bugweri (46%). The higher the adoption levels, the more Striga weeds were controlled. The increased adoptions and positive trends in control could be attributed to the perceived success in controlling Striga with improved crop yields. The affordability, accessibility and availability of the technologies greatly influenced the adoption of Striga control technologies. Awareness campaigns and extension services that provide services such as training and information are vital [33]. Lewicka (2011) [34] indicated that an individual’s adoption of innovation not only depends on individual attitudes but also on organizational policies, approaches and actions such as trainings[35], support & incentives [36]. The high adoptions in Iganga, Luuka and Namutumba may be associated to socio-cultural factors such as non skeptical attitudes or quick adoption of technologies by farmers due to social influence. [37] refered to such influence as normative beliefs about the appropriateness of adoption of innovation. The districts of Iganga and Luuka had no farmers with Tertiary education and very low number of farmers with secondary education. On the contrary, Bugiri districts with highly educated farmers had low adoption levels for Striga weed control technologies. The low adoptions of technologies by Bugiri farmers (High education) and higher adoptions by farmers in Iganga (Low education) may be attributed to factors such as ability to purchase equipment (eg. seeds or training), fear of risks, lack of access to resources and cultural resistance and insufficient support systems like extension services, training or experts to guide on using the technology. [38] attributed the adoption of innovations to demographic factors, peer and social networks. Bugweri and Luuka had farmers with low education and low levels of technology adoption. The recommended methods of controlling Striga include; proper seed selection, use of seeds that are Striga seeds weed free, regular plant monitoring, intercropping with legumes, hoeing and weeding before the Striga weeds start to flower.

**4.7 Sources, benefits, strengths, efficacy and accessibility of the major Striga control technologies**

Fellow farmers were the major (52%) source of technologies followed by extension staff (23%) and family members/parents (13%). Farmers’ self initiative (12%) is another method by which they coped up with *S. hermonthica* pandemic. The advantages of controlling Striga mentioned were to reduce the weed population and seed bank, reduce the crop/weed competition for soil nutrients, promotion of the non host plants, improve soil health and crop growth, reduce pest and disease infestations. The ultimate aim of employing such practices must be to prevent seed setting and realize better economic returns as a result of diminished infestation in the long run. The disadvantages of different methods reported by farmers included high costs and labor intensity besides hard to pull weeds that cause more weed sprouts under hand pulling. The incompatible crop rotations and mixtures that require extra skills and more land and seed were also observed. [39] reported that weed density was not affected by crop rotation length and about 98% of the weed species were indifferent to the factors applied. The researchers observed that the effect of crop rotations on weeds is hard to detect and the dorminance of some grass weeds were a consequent of inadequate management of late emergence and post harvest weeds. The study therefore implied that extra skills were needed in weed control. Crop rotation is known to modify seed banks, especially their composition [40]

**4.8 Quality attributes of the Striga control methods**

The common control methods were hand pulling of weeds and crop rotations with Striga non-host plants.

Hand pulling is not very effective as the Striga weed growth pattern, is complex, closely associated with its host root system and results into substantial damage like chlorosis, thin stalk, reduced height and total crop losses [6] A single Striga plant can produce up to 500,000 seeds capable of remaining viable in the soil for 20 years [41]. The Striga weeds life cycle is short and therefore the weed must be controlled early. [3] observed that Strigaspp. complete their life cycle in 10 weeks, normally after the host plant has been harvested. The life cycle of Striga Spp. involves germination, host attachment, haustoria formation/ penetration, vascular connections, nutrient absorption, flowering and production of seeds. The seeds germinate only in the presence of a host derived chemical signal called Strigalactone and germinaton is preconditioned by warm and moist conditions[9] Marro *et al.,* (2021).[42} indicated that the invasion of this parasite is hampered by the tremendous number and longevity of the seeds, vast genetic variability, complex life cycle,and subterranean natureof damage. The above attributes contribute to the control of Striga *Spp*. being difficult. Striiga weed control is difficult due to the nature of the association between host plants and parasites, which requires highly selective herbicides. Striga has prodigious seed production, A single Striga plant can produce up to 500,000 seeds capable of remaining viable in the soil for 20 years [41]. The prolonged viability of the seeds and the subterranean nature of the early stages of parasitism [43] The methods were easily accessible, relatively effective though labor intensive. Inorganic fertilisers and organic manure technologies was considered not readily accessible though effective and not labor intensive. Deep ploughing of Striga weeds was reported to be labor intensive/ expensive and not effective. [44] reported that soil management in tilled systems can replenish the soil seedbank by burrying the seeds on the surface and unearthing them in following seasons. Striiga weed control is difficult due to the nature of the association between host plants and parasites, which requires highly selective herbicides Striga has prodigious seed production, prolonged viability of the seeds and the subterranean nature of the early stages of parasitism [43].

**4.9 Effects of Striga on maize yield and types of farmer trainings**

Increased negative effects on maize yield in the past 5 years were reported by 68% of the farmers as 32% of farmers did not recognize change in maize yields and maize yield. The reported yield by male farmers was higher (2.5-3.0 Mt ha-1) than female counterparts (1.3-3.0 Mt ha-1) with an average yield of only 1.3 -3.0 Mt ha-1) The yield was relatively low compared to the normal average yield (4.5-5 0 Mt ha-1) and could be attributed to the serious Striga incidence reported in the districts, Lower yields by women could have resulted from the barriers they face such as access to land (fertile land) or credit, innovations and other resources restricting their opportunities to participate in profitable agricultural activities. [44] reported 66 percent maize grain yield reductions due to Striga weeds.

**4.10 Farmers trained in Striga control**

Extension workers or non government organisations had trained 55-65% of the farmers in Striga weed control during the past 5 years. The technologies included: crop rotation, hand pulling of Striga + burning, use of inorganic fertilisers and improved seeds/IR maize, weed control using 2-4 D herbicides, intercropping maize with legumes, deep ploughing and frequent weeding. [35] indicated that training leads to high adoption of technologies, The number of trained farmers should have been higher to enable the farmers manage the Striga weed more effectively. Look across districts why the difference, and provide some reference

**5. CONCLUSION**

Maize was the major crop in the study area and most susceptible to *Striga hermonthica* weed with high severities was known to all respondents. The declines in maize grain yield were iin all districts and high especially in Iganga (80%) and Bugweri (75%) districts. Farmers were controlling the Striga by hand pulling/rouging (82%), crop rotation (78%), deep ploughing (67%), fertilizer/manure (62%), intercropping (37%), frequent weeding (22%) and herbicides (17%). The Striga adoption rates were high in Iganga and low in Bugweri districts. Generally there were positive trends in the use of the *Striga* control technologies(46%-92%) for all districts and the percentage of farmers controlling *Striga* was high in IG (47%) and low in Namutumba (27%) district. The major source of Striga control methods was fellow farmers (52%), followed by extension staff (23%), family members13%) and self initiative (12%). There is need to train the Extension worker in Striga control technologies, since they imparted more knowledge to the farmers who were the major source of knowledge for the control technologies. Efforts have been made to develop eco-friendly approaches to combat the increasing effects of Striga weed on cereal crops. Sustainably, *Striga* control methods should target atleast one of the following goals: (i) *Restraint;* limiting new seed production by planting resistant varieties (Pre & post attachment), using fertilizers, applying appropriate herbicides, employing agronomic practices such as hand hoeing, burning, fallowing and application of chemicals (Allelochemicals) that reduce the release of germination stimulants by the host. NERICA rice varieties use this principle to reduce Pre & post attachment. (ii) *Prevention*: avoiding seed dispersal by using clean crop seeds, tools, fodder and controlling animal grazing or applying phytosanitary measures and (iii) *Reduction*: decreasing *Striga* seed bank in infested soils by using cultural practices such as trap crops, intercroping and crop rotations. Effective *Striga* management requires an integrated approach such as complementing host resistance with seed coating or integrating trap crops exhibiting suicidal germination and *Striga* specific herbicides with allelopathic potential to effectively deal with the *Striga* problem in African Agriculture.

**7.REFERENCES**

1. Kamara,A.Y., Menkir, A. Chikoye, D., Tofa, A .I.. Fagge, A, A., Dahiru, R., Solomon, R., Ademulegun, T., Omoigui, L.,  Aliyu, K .T. & Kamai N. (2020). MitigatingStriga hermonthica parasitism and damage in maize using soybean rotation, nitrogen application, and Striga-resistant varieties in the Nigerian savannas. *Exp. Agric.,* **56:**620-632

2. Akaogu, I, C.,  B. Apraku, B.,  Tongoona,  P.,  Ceballos, H.,   Gracen, V., S. K. Offei, S, K. D.  & Dzidzienyo. D. (2019), Inheritance of Striga hermonthica adaptive traits in an early-maturing white maize inbred line containing resistance genes from Zea diploperennis, *Plant Breed.*, **138:**546-552

3.Yacoubou, A, M., Zoumarou Wallis, N.. Menkir, A.,  Zinsou, V. A., A. Onzo, A.,  Garcia-Oliveira, A, L.,  Meseka, S., Wende, M. & Agre, G, P., (2021). Breeding maize (Zea mays) for Striga resistance: past, current and prospects in sub-Saharan *Africa Plant Breed.,***140**(2021):195-210

4.Oula, D. A., Nyongesah,J. M.,  Odhiambo, G., &  Wagai. S. (2020), The effectiveness of local strains of Fusarium oxysporium f. Sp. Strigae to control Striga hermonthica on local maize in western Kenya Food Sci. Nutr., **8**:4352-4360.

1. Dafaallah, A ,B. (2019), Biology and physiology of witchweed (Striga spp.): a review: *Int. J. Acad. Multidiscip*., **3**: 42-51

6. Menkir, A.,  J. Crossa, J., Meseka, S.,  Bossey, B.,  Muhyideen,  O.,  Riberio, P, F., Coulibaly, M.,  Yacoubou, A, M., Olaoye, G. &  Haruna. A, (2020), Stacking tolerance to drought and resistance to a parasitic weed in tropical hybrid maize for enhancing resilience to stress combinations

*Front. Plant Sci.*, **11**:166-174.

7. Mohamed, K ,I., Papes, M., Williams, R., Benz, B. W., Peterson A. T., (2006). Global invasive potential of 10 parasitic witchweeds and related Orobanchaceae. AMBIO **35**:281-288.

8.Lobulu, J., Shimelis, H.,  Laing,  M. &  Mushongi, A, A. (2019), Maize production constraints, traits preference and current Striga control options in western Tanzania: farmers’ consultation and implications for breeding, *Acta Agric. Scand. Sect. B Soil Plant Sci.,* **69**:734-746

9. Marro, N., Caccia, M. & López-Ráez, J, A (2021). Are strigolactones a key in plant – parasitic nematodes interactions? An intriguing question, *Plant Soil,***462**:591-60

10. Saboor, A., Ali, M, A.,  S. Hussain, S., H.A. El Enshasy, H, A.,  S. Hussain, S.,  Ahmed, N., Gafur, A.,  Sayyed,  R, Z., Fahad,S., Danish, S., & Datta, R.(2021). Zinc nutrition and arbuscular mycorrhizal symbiosis effects on maize (Zea mays L.) growth and productivity

*Saudi J. Biol. Sci.,* **28:**6339-6351

11.Acevedo-Siaca, L., P. D. Goldsmith, P,D., (2020), Soy-maize crop rotations in sub-Saharan Africa: a literature review, *Int. J. Agron.*[**10**.1155/2020/8833872](https://doi.org/10.1155/2020/8833872)

1. Stanley,A,E.,  A. Menkir,  A., Ifie, B., Paterne, A, A.,, Unachukwu, N, N.,  Meseka, S.,  Mengesha, W,A.,  B. Bossey, B.,  O. Kwadwo, O.,  P.B. Tongoona,P, B.., O. Oladejo,O.,  C. Sneller, C., M. Gedil, M. (2021), Association analysis for resistance to Striga hermonthica in diverse tropical maize inbred lines

*Sci. Rep.,***11**:1-14, [10.1038/s41598-021-03566-4](https://doi.org/10.1038/s41598-021-03566-4)

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1. Chukwudi, U., Kutu, F., S. Mavengahama, S., (2021), Mycotoxins in maize and implications on food security: a review *Agric. Rev.,* *42*(2021)

15.Aly, R., (2007), Conventional and biotechnological approaches for control of parasitic weeds

Vitr. Cell. Dev. *Biol. Plant,***43**:304-317

16.Jamil, M., T. Charnikhova,  T.,  Cardoso,C.,   Jamil, T., Ueno, K., Verstappen, F., Asami, T., Bouwmeester, H, (2021), Quantification of the relationship between strigolactones and Striga hermonthica infection in rice under varying levels of nitrogen and phosphorus, *Weed Res.*, 51 (2011), pp. 373-385,

17..Kaiira, M. G., Chemining’wa, G, N., Ayuke. F. & Baguma. Y. (2021). Allelopathic Potential of Compounds in Selected Crops. *Journal of Agricultural Science,* **13**(9):192-201.

1. Rich P, J. (2020), Genetic and management options for controlling Striga, Sorghum in the 21st century: Food. Fodder. Feed. fuel for a rapidly changing world, Springer, 421-451

19. Lendzemo, V.,  Kuyper, T, W., Kropff, A, M.,  van Ast, A, V. (2005), Field inoculation with Arbuscular mycorrhizal fungi reduces Striga hermonthica performance on cereal crops and has the potential to contribute to integrated Striga management, *Field Crops Res.,* **91**:51-61,

20.Mthi. S., Yawa. M., Tokozwawo. S., Ikusika, O. O., Nyangiwe. N., Thubeka. T., Tyasi. T. Washaya. L., Gxasheka. M., Mpisa. Z., & Nkohla. M. B. (2021). An assessment of Youth involvement in Agricultural Activities in Eastern Cape Province, South Africa. Agriculturakl Sciences, **12**(10):1034-1047. 10.42366/as.2021.1210066.

1. Geza, W., Ngidi. M., Ojo. T., Adetoro. A. A., Slotow. R. & Mabhaudhi. T. (2021). Youth participation in Agriculture: A scoring Review. *Sustainability*, **13** (16):9120 http://doi.org/10.3390/su13169120

22.Girdziute. L., Besusparience. E., Nausediene. A.., Novikova. A., Leppala. J. & Jakob. M. (2021). Youth’s (Un)willingness to work in agriculture sector. *Front. Public Health*. **10**. https/doi.org/10.3389/fpubn.2022.937657.

1. Dunne. T. and Troske. K (2005). Technology adoption and the Skill Mix of U.S. Manufacturing Plants. Scotish *Journnal of Political Economy* **52**:387-405.

24.Fasakin, I. J., Ogunniyi, A. I., Bello. L. O., Mignouna, D., Adeoti, R.. Bamb, Z., Abdooulaye. T.., Awotide, B. A. (2022). Impact of intensive youth participation in Agriculture on Rural households’ revenue: Evidence from rice farming households in Niigeria. *Agriculture.* **12**,584. http://doi.org/10.3390/ agriculture 12050584.

25.Kaiira M, G., Omiat G, M., Kasozi, N., Gigoi, R., Kagoda.F. & Elesu, M. (2025, *In press*).Exploring Synergies: The Benefits of Maize - Legume Intercropping in Agroecosystems of Eastern Uganda. *European Journal of Applied Sciences.*

26. Atera E, A Ishii T, Onyango J, C., Itoh, K,. Azuma T (2013). Striga infestation in Kenya status, distribution, and management options. *Sustain Agric. Res*. **2:**99-108.

1. Ahmad. M. F., Ahmad. F. A., Abdulrahman, A., Alsayegh, M. Z., Abdulla. M., AlShahrani. M., Khursheed, M., Abdullah, A. S., Shadma., Elbendary E. Y., Kambal. N., Abdelrahman. M. H. & Hussain, S. (2024). Pesticides impacts on human health and the environment with their mechanisms of action and possible countermeasures. *Heliyon.* https://doi.org/10.1016/j.heliyon.2024.e29128.
2. Tadesse F (2018). Effect of Striga trap crops and nitrogen fertiliser application on yield and yield released traits of Sorghum Sorghum bicolar L,) (Moench) at Fedis District, Eastern Ethiopia, Open acess Lib.5:1-17.

29.Randrianjafizanaka M. T, Autfay P, Andrianaivo A, P., Ramota I, R., Rodenberg J (2018). Combined effects of cover crops, mulch, zero tillage and resistant varieties on Striga asiatica (L) Kuntze in rice -maize rotation systems. Agric *Ecosyst Environ* 256:23-33.

1. Midega C .A.., Wasonga C. A., Hopper A ,M., Prickett J, A.,Khan Z ,R, (2017). Drought torerant Desmodium species effectively suppress parasitic Striga weeds and improve cereal grain yields in western Kenya.Crop Prot. **98:**94-101.
2. Hailu G., Nassy S., Zeyaur K. R., Ochatum N., Subramanian, S (2018). Maize-legume intercropping and Push pull for management of fall armyworm stemborers and Striga in Uganda. *Agronomy J.* **110:** 2513-2522.

32.Kanampiu F., Makumbi D., Mageto E., Omanya G., Waruingi S., Musyoka P., Ransom J., (2018). Assessment of managent options on Striga infeststions and maize grain yield in Kenya*. Weed Sci.* 66: 516-524.

33.Peansupap, V & Walker D (2005). Exploratory factors influencing information and communication technology diffusion and adoptiom within Ausralia constrution organizations. A micro analysis. Construction.  *Innovation*, **5**(3)135-157.

34.Lewicka D. (2011). Creating Innovative attitudes in an Organization - Comparative Analysis of Tools Applied in IBM Poland and ZPAS Group. **I**(1):1-12

35.Al- Gahtani, S.. & King, M. (1999). Attitudes, satisfactionand usage: Factor contributing to each in the acceptance of information technology. *Behaviour & Information Technology*. **18**(4). 277 - 297.

1. Igbaria, M., Parasuramam, S.& Baroudi J,, (1996). A motivational model of microcomputer usage.*Journal of Management Information Systems.* **13**(1), 127-143
2. Talukder, M. & Quazi A. (2011). The impact of social influence on individuals’ adoption of innovation. *Journal of Organizational Computing and electronic Commerce,* **21**(2). 111-135.

38.Talukder M (2012). Factors affecting the adoption of technological innovation by individual employees; An Australian Study. Procedia - *Social and Behavioral Science.* **40**;52-57.

39.Otto. S., Masin. R., Nikolic. N., Berti. A. & Zonin. G. (2023). Effect of 20 - years crop rotation and different strategies of fertilization on weed seedbank. *Agriculture Ecosystems & Environment.* 354: 108580.

40.Adhikary. P., & Gosh. R. K. (2014). Effects of cropping sequence and weed management on density and vertical distribution of weed seeds in alluvial soil. J*. Crop weeds.* **10**(2): 504-507

41. Lobulu, L.., Shimelis, H., Laing, M., Mushongi, A .A., (2019). Maize production constraints, trait preference and current Striga control options in western Tanzania: Farmers consultation and implications for breeding*. Acta. Agric. Scand. Sect. B. Soil Plant. Sci,* **69:**734-746.

42 Huang, K., Whitlock, R., Press, M., Scholes, J., (2012). Variation for host range within and among populations of the parasitic Strida hermonthica, *Heredity,* 108:96-104.

1. Huang K, Whitlock, R., Press, M., Scholes J (2012) Variation for host range within and among populations of the parasitic plant Striga *hermonthica*. Heredity 108:96-104.

44. Travlos, L., Gazoulis,L., Kanatas, P., Tsekoura, A., Zannopoulos, S. & Papastylianou, P., (2020). Key factor affecting weed seeds germination, weed emergence and their possible role for the efficacy of false seedbed technique as weed management pracctice. *Front. Agron.* 2(March),1-9.

45.Sallah, P. Y. K., & Afribeh, D. (1998). Effects of *Striga hermonnthica* infestation on improved maize cultivars in Ghana. *Ghana Journal of Agricultural Science*. 31(187-195.