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ASSESSING THE EFFECT OF FALL ARMYWORM ON MAIZE IN NAMWAYA VILLAGE, NAGONGERA SUB-COUNTY, TORORO DISTRICT.

BY

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A RESEARCH REPORT SUBMITTED TO THE DEPARTMENT OF BIOLOGY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE OF BUSITEMA UNIVERSITY.

2024

Declaration

I, Kibet Daniel, declare that to the best of my knowledge, this research is my own and it has never been for someone else for consideration of any certification at this or any other university or institution of higher learning. The research proposal has been completed by references duly acknowledged.

Students signature... Date...15.09.2024...............

Approval

This research report will be submitted for examination with approval of the following supervisor.

Signature……………………………………… Date 13th/09/2024……

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ACKOWLEGEMENT

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Acronyms and Abbreviations

FAW	Fall Armyworm
FAO	Food and Agricultural Organization
SSA	Sub Saharan Africa

Contents

1.5 Abstract:

The invasion of fall armyworm (FAW), Spodoptera frugiperda, has posed a significant threat to maize production globally. This study aimed to assess the effect of fall armyworm on maize crops in Nagongera Sub- County, Tororo District, with a focus on quantifying its prevalence and examining its impact across different levels of infestation. Two maize gardens were selected for the study, and data were collected to determine the prevalence of fall armyworm infestation. The objectives of the study were to quantify the prevalence of fall armyworm and to survey and examine its impact on maize crops. Data collection involved systematic sampling and examination of maize plants in the selected gardens. The percentages of fall armyworm infestation were recorded for four categories: low, moderate, high, and non-affected maize crops, in both garden 1 and garden 2. The results revealed varying levels of fall armyworm prevalence across the two gardens. In garden 1, the percentages of infestation for low, moderate, high, and non-affected maize crops were recorded as 14.5%, 19.0%, 28.4%, and 38.1% respectively. Similarly, in garden 2, the percentages were 14.9%, 21.1%, 28.1%, and 35.8% for the same categories of infestation. These findings highlight the significant prevalence of fall armyworm in maize crops within Nagongera Sub- County, Tororo District. The variation in infestation levels between the two gardens underscores the importance of localized assessments and targeted interventions to mitigate the impact of fall armyworm on maize production. Further research is recommended to explore integrated pest management strategies tailored to the specific needs of affected areas, with a focus on sustainable solutions to ensure food security and agricultural resilience in the face of pest threats.

1.6 CHAPTER 1.0: INTRODUCTION

1.6.1BACKGROUND

The fall armyworm (*Spodoptera frugiperda*), is a polyphagous pest, it prefers maize but can infest over 350 plant species, including important crops like rice, sorghum, wheat ,cotton, soybean and sugarcane(Overton, Maino et al. 2021). The fall armyworm belongs to:

Domain	Eukaryotic
Kingdom	Metazoa
Phylum	Arthropoda
Subphylum	Unirama
Class	Insecta
Order	Lepidoptera
Family	Noctuidae
Genus	Spodoptera
Species	*Spodoptera frugiperda*

It has been assumed that fall armyworm disperses on wind assisted by flights until they are sexually mature and ready to mate(Withers 2021). The fall armyworm has several generations per year, with the lifecycle consisting of eggs, six to seven larval stages, pupa and adult(Marri, Mensah et al. 2023). Completion of lifecycle takes about 4 weeks, it can also take about 12 weeks during periods of high temperatures and the number of instars can range from six to seven depending on environmental conditions (Sukovata 2019).

Fall armyworm is a notorious pest causing serious damage to the maize especially during the early stages of maize growth (Mallapur, Naik et al. 2018). The larval stage is the most dangerous stage of the fall armyworm (Acharya, Hwang et al. 2020) and it causes serious damages on leaves, stems of maize reducing crop yield by destroying the photosynthetic tissues of maize crops. Fall armyworm causes substantial losses due to decline in crop productivity.

This is due to its high rate of reproduction and the ability to fly to distant areas while destroying maize (Chimweta, Nyakudya et al. 2020). Farmers therefore, encounter a lot of losses and this has reduced marketing of maize resulting in poverty especially in Nagongera Sub County.

1.6.2 Statement of the problem

Fall armyworm has a long history of outbreaks in the United States of America. The pest is a native to America (Nagoshi, Goergen et al. 2018).It has rapidly spread to several regions worldwide, causing extensive damage to crops especially maize resulting in a global threat to food security (Tyczewska, Woźniak et al. 2018). The presence of fall armyworm was initially reported in Karnataka in 2018 in India (Navik, Shylesha et al. 2021). Within a span of 1-3 years, the pest rapidly spread in India and then to other Asian countries and Oceania(Zeng, Reddy et al. 2019). (Dagestani, Qing et al. 2022). Since then, it has become a resident in most sub Saharan countries where severe damage on maize is observed.it was detected in Africa in 2o16 in Nigeria (Gichora, Kojwang et al. 2017). The fall armyworm was intercepted on a few hectares of integrated maize fields in southern Ethiopia in February, 2017 (Omwoyo 2021).

The fall armyworm was detected in Uganda in 2016 and it caused serious devastation to crops towards the end of 2018(Sharon, Michael et al. 2020) and the pest sprung and farmers did not have a proper solution to manage it.in Uganda, the pest attacks crops such as cotton, maize, sorghum among others (Lubadde, Ebiyau et al. 2019). Currently, fall armyworm is a notorious pest affecting various maize gardens in Nagongera sub-county, Tororo district.it damages the leaves, young stems of maize in the garden. This has resulted into serious famine and poverty as well due to a decrease in maize productivity. However, the purpose of this study is to assess the overall level of damage caused by the fall armyworm, quantify the extent of damage caused by the fall armyworm and to examine, survey and document the prevalence and distribution of fall armyworm Namwaya village, Nagongera sub-county, Tororo district.

1.6.3 Objectives

1.6.4 General objective

To assess the overall level of destructiveness caused by the fall armyworm.

1.6.5 Specific objective

To quantify the extent of damage caused by the fall armyworm on the crop yield and quality.

To examine survey and document the prevalence and distribution of Fall armyworm in the study area.

1.6.6Hypothesis .

The null hypothesis.

The level of destructiveness of fall armyworm in maize gardens in Nagongera sub-county is not significant.

Fall armyworm infestation does not significantly affect maize production in the study area.

1.6.7 The alternative hypothesis

The level of destructiveness of fall armyworm in maize gardens in Nagongera sub-county is significant.

Fall armyworm infestation significantly affects maize production in the study area.

1.6.8Justification of the study

Maize is of great value since it contributes to most of the food consumed and also a cash crop, it is panted by a large number of farmers in Uganda. However, the crop faces a serious threat by the fall armyworm which causes damage to the crop by eating up leaves and other parts of the plant resulting into a great loss. Therefore, this research is aimed at assessing the level of damage by the Pest, examining its effects and determining the effective control strategy to reduce on the pest infestation. Assessing the effect of fall armyworm in maize gardens within Nagongera sub-county is significant for quantifying the extent of damage by the fall armyworm

1.6.9 Scope of the study

This research study aimed at assessing the effect of fall armyworm, Namwaya village, Nagongera Sub County in Tororo district.

2.0 CHAPTER 2.0; LITERATURE REVIEW

The Spodoptera genus have 31 species in the world .Farmers in maize growing regions have resorted to using two rounds of insecticides to manage fall army worm (Akeme, Ngosong et al. 2021) . Since then, it has become resident in most sub-Saharan countries where severe damage in maize fields is observed (Mulungu and Ng'ombe 2019). Native to the Americas continent and eight species are in African continent fall armyworm emerged in Ghana in 2017 as a major threat to maize production in the country (Otim, Fiaboe et al. 2021). Considering that maize is the stable food crop in the country, any shock in its production can cause major consequences on the food security of the country (Grote, Fasse et al. 2021). The extent of the impact of the Fall armyworm on agricultural products differs in severity and appearance depending on the cultural practices and type of grass (Akeme, Ngosong et al. 2021). The fall armyworm is a migratory insect pest known to cause destruction to maize crops during humid conditions in the Americans(De Groote, Kimenju et al. 2020). The end of 2017, about 38 countries in Africa were invested with the FAW the suitable climate in Africa favors the growth of main and alternative hosts of the FAW (Matova 2021).

2.1 DESCRIPTION OF FALL ARMYWORM

Eggs are laid at night on the leaves of the host, stuck to the lower surface of the lower part of the leaves, in tight clusters of 100-300 and sometimes in two layers, usual covered with a protective layer of abdominal bristles (Kunjwal and Srivastava 2018). Hatching requires 2-10 days (usually 3-5). The young larvae feed deep in the whorl; the first two instars feed gregariously on the underside of the young leaves (Narayanamma, Reddy et al. 2020) causing a characteristic skeletonizing or 'windowing' effect, and the growing point can be killed. Larger larvae become cannibalistic and thus one or two larvae per whorl are usual

2.1.1REPRODUCTION SYSTEM OF FAW

MATING

A female attracts males by perching atop the host plant feeding area and releasing a sex pheromone as the signal that she wishes to mate (Huber, Moore et al. 2019) . Each female only mates once per night; this creates a physical conflict between the multiple males that will fly towards a ready female (Prum 2018) next, and females who have already mated multiple times call and mate last during the night

2.1.2 LIFECYCLE OF FALL ARMYWORM

The life cycle is completed in about 30 days during the summer, but 60 days in the spring and autumn, and 80 to 90 days during the winter (Honek, Martinková et al. 2018). The number of generations occurring in an area varies with the appearance of the dispersing adults. The ability to diapauses is not present in this species.

2.1.3 EGGS

The egg is dome shaped, flattened base and the egg curves upward to a broadly rounded point at the apex, The egg measures about 0.4 mm in diameter and 0.3 mm in height (Das, Paradkar et al. 2021). The number of eggs per mass varies considerably but is often 100 to 200, and total egg production per female averages about 1500 with a maximum of over 2000, the eggs are sometimes deposited in layers, but most eggs are spread over a single layer attached to foliage(Ibrahim and Jimma 2018). The female also deposits a layer of grayish scales between the eggs and over the egg mass, imparting a furry or moldy appearance (Das, Paradkar et al. 2021)

2.1.4 LARVA

There usually are six instars in fall armyworm. Head capsule widths are about 0.35, 0.45, 0.75, 1.3, 2.0, and 2.6 mm, respectively, for instars 1-6 (Das, Paradkar et al. 2021). Larvae attain lengths of about 1.7, 3.5, 6.4, 10.0, 17.2, and 34.2 mm, respectively, during these instars In the second, but particularly the third instars, the dorsal surface of the body becomes brownish, and lateral white lines begin to form (Manjula, Saheb et al. 2019). In the second, but particularly the third instars, the dorsal surface of the body becomes brownish, and lateral white lines begin to form (Okude, Fukatsu et al. 2021).

2.1.5 IMPACT ON CROP PRODUCTION

Available evidence suggest that fall armyworm is difficult to manage. This is primarily because of its feeding and sheltering behavior on host plant (Assefa 2018). However, responding with pesticide control reduces profit thresholds for those farmers who grow maize for commercial purposes (Grovermann, Schreinemachers et al. 2017). The SSA maize production environment is traditionally burdened by abiotic and biotic stresses. Fall armyworm feeds on foliage, reproductive parts, grains and grain. Feeding on foliage reduces economic yields by causing injury to the plant, including dead heart and reducing the photosynthetic area, whereas feeding on reproductive parts inhibits or reduces fertilization and grain formation hence reduced final grain yield.

2.1.6 DAMAGE CAUSED BY FALL ARMYWORM

Fall armyworm attacks all above-ground parts of maize including leaves, ears and tassels, often leading to severe defoliation and reduced photosynthesis(Aasfar, Bargaz et al. 2021). Fall armyworm damage cause up to 100% crop failure. The crop growth stage during infestation has a marked relationship with yield loss. For instance, in Ethiopia, a yield loss of 30% was reported when infestation occurred during the late whorl growth(Usmael 2019). Different growth stages and the impact of maize are seen in most gardens.

Infestation occurring at the seedling and early-whorl stages (4 to 8 leaf stage) causes defoliation of Apical meristematic damage(Kasoma, Shimelis et al. 2021). typically, defoliation of maize rarely exits 50% because of the ability of maize to compensate for foliar damage caused by fall armyworm., however low yielding varieties, poor nutrition and field management practices affects the ability of maize to compensate for foliar damage caused by the Pest. During the mid- whorl stage (5 to 8 leaf stage), the fourth to sixth instar larvae bore into the whorl, causing extensive damage leading to significant yield loss or crop failure.at tasseling (12 to 14 leaf stage), the fall armyworm move to the tassel, causing injury and reduced pollen production and fertility (Kasoma, Shimelis et al. 2021).

2.1.7 CONTROL MANAGEMENT STRATEGIES

INTERGRATED PEST MANAGEMENT

Integration of various compatible fall armyworm management strategies, cultural practices, bio control and host-plant resistance, is internationally recommended. Host plant resistance is pivotal in integrated fall armyworm management, especially for subsistence farmers (Yigezu and Wakgari 2020) and the damage of fall armyworm call for integrated pest management control approach which should be tested and deployed in SSA for effective management of the fall armyworm.

2.1.8CHEMICAL CONTROL

Synthetic chemicals are widely used, with varying success rates, to control fall armyworm globally(Sisay, Tefera et al. 2019),because of the unexpected appearance of fall armyworm in SSA, methyl parathion, chlorpyrifos, methamidophos, and phoxim are among the common chemical pesticides used.

2.1.9 BIOLOGICAL CONTROL METHOD

Some biocontrol agents reportedly feed on or toxic to fall armyworm eggs or larvae, whereas others have been shown to prevent reproduction of fall armyworm(Otim, Fiaboe et al. 2021) and in North and South America, several biological agents have been used,these include telenomus Remus Nixon.

3.0 CHAPTER 3.0; METHODOLOGY

Introduction

The researcher employed both qualitative and quantitative approach to collect data . Data collection involved a descriptive and exploratory design to accurately give clear information on how the FAW invades the plant parts such as leaves, young stems among others and to determine the extent of damage on maize, its effects and the available control measures. The data got was used to quantify the effects of the FAW.

3.1 Study area

The research was carried on the maize planted on Nagongera Sub County in Tororo district.

Nagongera Sub County is located in west Budama north constituency and is bordered by Paya sub county on the North, Nagongera town council on South. And West by Kisoko sub county on the Eastern region

3.2 Target population and sample

The research targets basically farmers who grow maize both men and women to reduce on biasness in Nagongera sub county. Quota sampling technique will be used to collect data from maize farmers in Nagongera sub-county

3.3 Design of the study

The study was be conducted using Field survey technique with the aid of scoring sheet, inspection to assess the level of destructiveness of the fall armyworm.

3.4 Procedure for data collection

Data collection comprised of various techniques such as systematic field survey which involves recording of data with the use of a scoring sheet. The scoring sheet was used to assess the level of damage of the Fall armyworm. The table below show data was collected from the field.

Rating scale for assessing fall armyworm damage in maize using percentage leaf feeding

Category	**Leaf feeding damage (%)**	**Description**	**Number**
A	0-10	Plants with no damage, windowing signs on leaves, up to five pinholes/leaf	
B	11-20	● Up to eight pinholes per leaf, ● Up to five clearly visible shot holes per leaf ● One to two elongated lesions per leaf ● Leaf whorls of one to three plants eaten up	
C	21-30	More than ten pinholes ● Up to ten clearly visible shot holes ● 3–5 elongated lesions per leaf	

		● Leaf whorls of up to five plants eaten up	
D	31-40	Up to ten clearly visible shot holes per leaf ● Up to five elongated lesions ● Up to three clearly visible portions eaten away per leaf ● One to two dying areas on a leaf ● Leaf whorls of more than five plants eaten up	
E	41-50	More than eight elongated lesions per leaf ● More than five portions visibly eaten away ● More than two dying portions on leaf ● Leaf whorl almost entirely eaten (away dead heart with signs of new shoot)	
F	50>	● Dead heart with no signs of new shoot ● Dying or dead plant ● Severely damaged plant	

The table below shows the leaf feeding damage, description and level of damage by the fall armyworm.

CATEGORY	LEAF FEEDING DAMAGE (%)	DESCRIPTION	LEVEL OF PEST DAMAGE
A-B	0-20	● Plants with no damage, windowing signs on leaves, up to five pinholes Up to eight pinholes per leaf, ● Up to five clearly visible shot holes per leaf ● One to two elongated lesions per leaf ● Leaf whorls of one to three plants eaten up	Low
C-D	21-40	More than ten pinholes ● Up to ten clearly visible shot holes ● 3–5 elongated lesions per leaf	Moderate

		● Leaf whorls of up to five plants eaten up Up to ten clearly visible shot holes per leaf ● Up to five elongated lesions ● Up to three clearly visible portions eaten away per leaf ● One to two dying areas on a leaf ● Leaf whorls of more than five plants eaten up	
E-F	40-100	More than eight elongated lesions per leaf ● More than five portions visibly eaten away ● More than two dying portions on leaf ● Leaf whorl almost entirely eaten (away dead heart with signs of new shoot) ● Dead heart with no signs of new shoot ● Dying or dead plant ● Severely damaged plant	High

4.0 CHAPTER 4.O RESULTS

This section presents the results obtained from the surveys carried out in the study area. The data was collected from two gardens. Maize in garden one was planted on 20th. February. 2024.this was reported by the farmer. The data was collected on 2 month aged maize crops (8 weeks). Maize where about to flower. The garden was a half an acre having more than 565 individual maize crops including both the affected and non-affected maize. Garden 2 had maize crops of medium size of one 4 weeks old. The garden was aquater an acre.

TABLE: 3

Table 3. The number of affected maize and non-affected maize in Garden 1

Rows of maize	Low damage	Moderate damage	High damage	Non affected	Total
R1	12	10	15	23	60
R2	10	15	19	18	62
R3	3	5	15	12	35
R4	6	10	12	16	44
R5	9	12	14	28	63
R6	8	11	13	27	59
R7	6	10	17	28	61
R8	11	16	17	25	69
R9	10	18	22	11	61
R10	9	12	15	14	50
TOTAL	84	119	159	202	564

Table 3 above shows the real picture of the effect of fall armyworm. The data was quantitatively put in the table above. Information was specifically got from the ten rows of maize as indicated by the symbols R1, R2, R3, R4, R5, R6, R7, R8, R9, and R10.these rows acted as a representative of the whole acre of land. Each row of maize was assessed separately basing on the level of damage that is; low damage, moderate damage and high damage depending on the description on table 3 above. The total number of maize per row where also counted including the non-affected maize in the garden. similarly, percentages where also calculated depending on the intensity of damage per row. It was found that, low damage, moderate damage, high damage and non-affected maize accounted for 14.9% ,21.1%, 28.1% and 35.8% respectively.

Calculations for garden 1

Number of maize affected or non affected/Total number of maize*100%

Low damage

84/564*100=14.9%.

Moderate damage

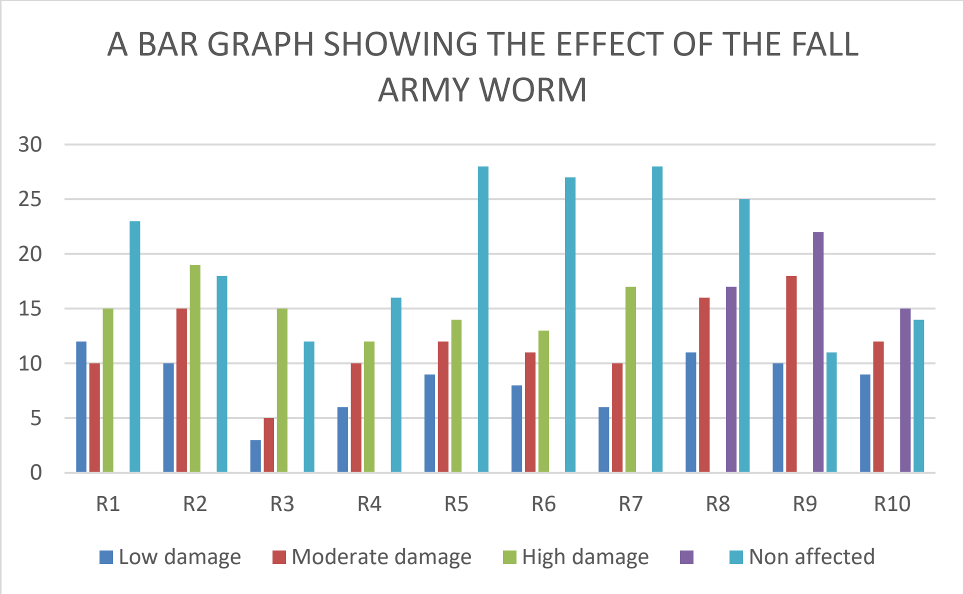
119/564*100=21.1%.

Highly Affected maize

159/564*100=28.1%.

Non Affected maize.

202/564*100=35.8%.



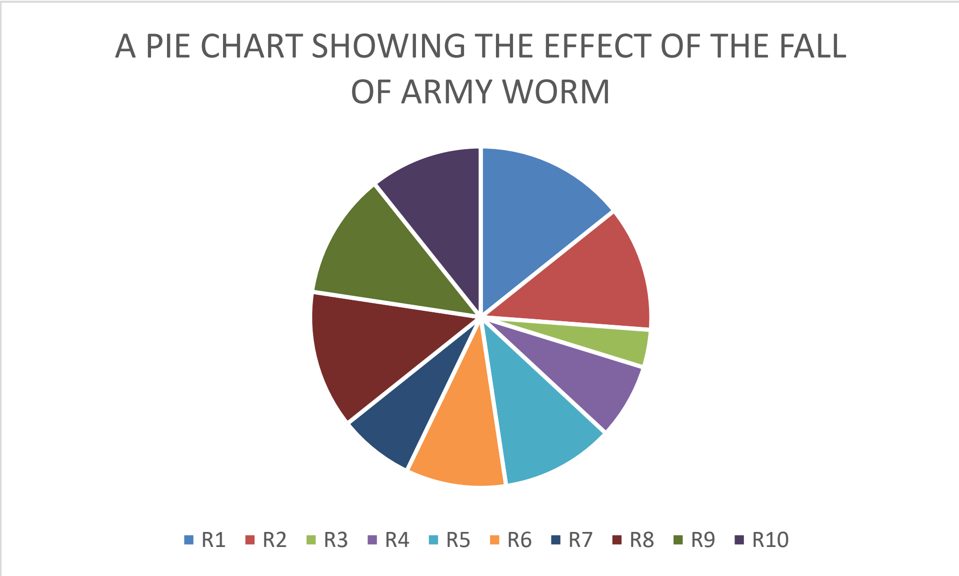


TABLE 4 SHOWING THE EFFECT OF FALL ARMYWORM ON MAIZE IN GARDEN 2

ROWS OF MAIZE	LOW DAMAGE	MODERATE DAMAGE	HIGH DAMAGE	NON-AFFECTED	TOTAL PER ROW
R1	4	4	8	15	31
R2	5	8	10	17	40
R3	6	7	9	10	32
R4	5	6	10	20	41
R5	4	6	10	13	33

R6	4	5	9	12	30
R7	3	7	8	16	34
R8	8	10	11	8	37
R9	6	6	10	3	25
R10	3	4	9	12	28
TOTAL	48	63	94	126	331

Table 4 above shows the total number of maize damaged by fall armyworm. details include all the rows that is, R1, R2, R3, R4, R5, R6, R7, R8, R9 and R10.Percentage damage was calculated on at each level of maize destruction, low damage contributed 14.5% and 19.0%,28.4%,38.1% for moderate damage, high damage and non-affected respectively. Results in garden 2, signify that a very small percentage of maize is unaffected as compared to the affected maize. This means that most crops are eaten up by the worm.The calculations for the damage is as shown below

Low damage

48/331*100=14.5%

Moderate damage.

63/331*100=19.0%.

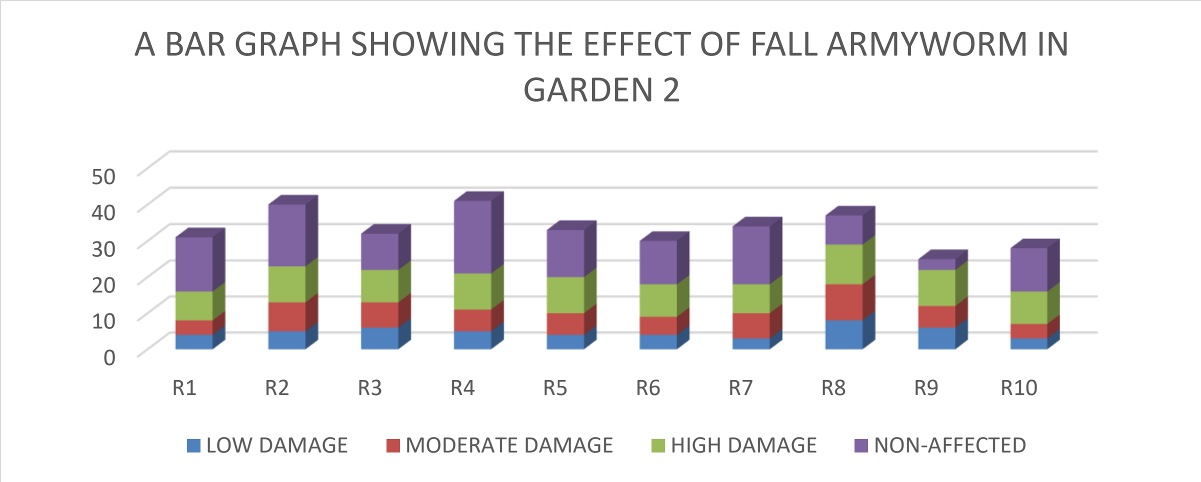
Highly damaged.

94/331*100=28.4%.

Non-affected maize.

126/331*100=38.1%.

Each row at least had spots of pest damage. Level of damage in this garden is illustrated in the bar graph below.



Un affected maize **Highly damaged**

Low damage

Moderate damage

The study aimed to assess the effect of fall armyworm in Nagongera sub-county, Tororo district. The results show that fall armyworm is having a significant detrimental impact on maize production in the area. The infestation of Fall armyworm has led to reduced crop yields, increased in pesticide use, and significant economics losses for farmers. Fall armyworm causes considerable threat to food security and agricultural sustainability in Nagongera

5.0 Discussion

Fall armyworm is a destructive pest that attacks maize, leading to insufficient yields and severe crop damage.According to my analysis, I found out that maize at a younger stage are less affected by Fall armyworm,this is because they can easily compensate the parts eaten by the fall armyworm,this stage is associated with rapid growth rate, new leaves can easily emerge out.This agrees with (Aasfar, Bargaz et al. 2021).Since data was collected from two gardens, with each garden having different stages of maize growth, garden one had reached the flowering stage, the results signify that Fall armyworm is so serious as compared to the younger stage and the middle stage, This also agrees with (Kasoma, Shimelis et al. 2021). Fall armyworm damage cause up to 100% crop failure. This infestation of fall armyworm in Nagongera sub-county has caused stress and financial burdens to farmers, decreased food availability, and increased cases of famine, which result in high cases of malnutrition.

6.0 Conclusion

Based on the findings of the study; Assessing the effect of fall armyworm in nagongera sub-county, Tororo district, it is evident that the presence of fall armyworm (destructive pest) has led to significant negative impacts on maize production in the area. The infestation of fall armyworm has resulted in reduced crop yields, increased pesticide use, and economic losses for farmers.The livelihood of many people have been altered negatively since the effect of fall armyworm is associated with malnutrition, maize is the main source of carbohydrates.This has diminished nutrition protocol through the pest damage on maize.Poverty has also resulted through loans with the reason of minimizing pest by spraying the gardens with pesticides. Most farmers borrow money from banks and other people to buy the chemicals for spraying. This has resulted in social misunderstanding amongst people, therefore, Urgent action is needed to address this issue and prevent further damage to agricultural production and food security in the region

7.0 Recommendations

I therefore recommend the use of Intezgrated Pest Management (IPM) Strategies, Implementing IPM strategies is more effective to manage fall armyworm infestations because combines all the control measures thus the pest has higher chances of being killed. This approach involves a combination of cultural, biological, and chemical control methods tailored to the local context. Farmers should be educated and trained on IPM techniques such as crop rotation, intercropping, use of biological control agents like natural enemies of fall armyworm larvae, and application of pesticides.

Early Detection and Monitoring by establishing regular monitoring systems to detect fall armyworm infestations at an early stage is essential for timely intervention. Farmers should be equipped with knowledge and tools for identifying fall armyworm symptoms and monitoring population dynamics in maize fields. This enables prompt action to prevent widespread damage and minimize yield losses.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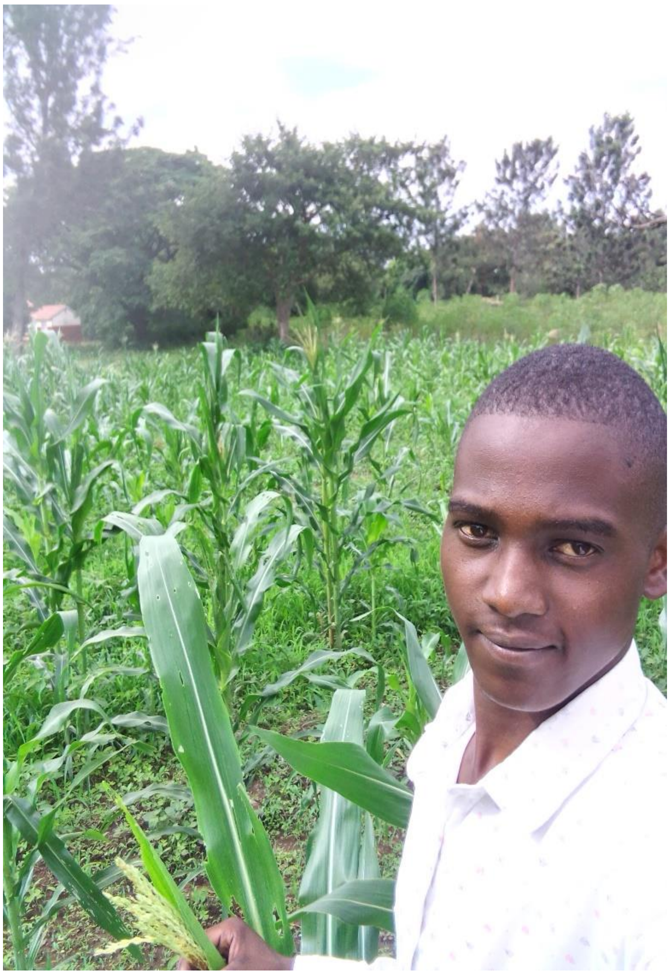

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