
**FACULTY OF AGRICULTURE AND ANIMAL SCIENCE
DEPARTMENT OF CROP PRODUCTION AND MANAGEMENT**

**COMPARATIVE ASSESSMENT OF THE EFFICACY OF EMAMECTIN
BENZOATE 5.7% AND 5 % ON THE CONTROL OF TOMATO FRUIT
BORER ON TOMATOES IN UGANDA**

BY

KIBALE NATHAN

BU/UP/2018/3881

nathakibale18@gmail.com

TEL: 0775120047/0701371463


SUPERVISOR: MR. AMAYO ROBERT

**RESEARCH REPORT SUBMITTED TO THE DEPARTMENT OF CROP
PRODUCTION AND MANAGEMENT IN PARTIAL FULFILMENT OF
THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN
AGRICULTURE AT BUSITEMA UNIVERSITY**

JUNE, 2023

DECLARATION

I, **KIBALE NATHAN** declare that this research report submitted to the department of Crop Production and Management for examination in consideration for the award of degree of Bachelor of Science in Agriculture (BSA) is my work and personal effort which I carried out, and that to the best of my knowledge has never been previously presented to Busitema University or elsewhere for the award of any academic qualification. I hereby affirm that this work is a result of my own research findings and that it has not been presented to any institution for any award.

Sign:  Date: 15th / 06 / 2023

APPROVAL

This work was under the supervision of:

Signature  Date 04/7/2023

MR. AMAYO ROBERT

Academic Supervisor

Lecturer in the Department of Crop Production and Management, Faculty of Agriculture and Animal Sciences, Busitema University

DEDICATION

I dedicate this report to my beloved parents MR. Mudde Samson, Nabuduwa sarah, Nabulobi Annet Janet and my supervisor Mr. Amayo Robert, who have tireless supported me thought this journey of academics and through the course of this project.

ACKNOWLEDGMENT

I would like to acknowledge God in all my endeavors for the gift of good health, wisdom, love, care, providence and protection throughout the journey of academia. I thank my academic supervisor Mr. Amayo Robert for the parental love, guidance and all the support he rendered to me during the research process am really grateful. I acknowledge the Busitema University Arapai campus most especially research coordinator Dr. Opiyo Peter, Dr. Lubadde Geoffrey and entire department of crop production and management for their support and guidance academically, may God bless you. With great honor I appreciate my parents Mr. Mude Samson and Nauduwa Sarah, Aunt Nabulobi Annet and Mr. Mooli Albert for the endless love and support, financially moral guidance and spiritual support they rendered unto me. Not forgetting my siblings and friends for the support and encouragement may the almighty God bless you abundantly

TABLE OF CONTENTS

DECLARATION.....	i
APPROVAL	ii
DEDICATION.....	iii
ACKNOWLEDGMENT	iv
LIST OF TABLES AND FIGURES.....	vii
LIST OF ACRONYMS	viii
CHAPTER ONE	1
1. INTRODUCTION.....	1
1.1. Background	1
1.2. Problem statement	2
1.3. Justification	2
1.4. Objective	3
1.4.1. Main objective	3
1.4.2. Specific objective	3
1.4.3. Hypothesis.....	3
1.5. Significance.....	3
1.6. Scope	4
CHAPTER TWO	5
2. LITERATURE REVIEW	5
2.1. About tomato fruit borer.....	5
2.1.1. Biology of tomato fruit borer	5
2.1.2. Identification of the tomato fruit borer.....	6
2.1.3. Symptoms and signs of the presence of the tomato fruit borer	6
2.2. The occurrence and distribution of the tomato fruit borer.....	7
2.3. Effect of the tomato fruit borer on the production of tomatoes.....	7
2.4.1. Cultural control.....	7
2.4.2. Use of host resistance	8
2.4.3. Biological control.....	8
2.4.4. IPM strategy	8
2.4.5. Chemical control	9
2.5. Effectiveness of Emamectin benzoate on management of tomato fruit borer.....	9
CHAPTER THREE.....	10

3.0. METHODOLOGY	10
3.1. Study location	10
3.2. Material	10
3.3. Treatments	10
3.4. Research design	11
3.5. Experimental design and lay out	11
3.6.1. Establishment of nursery	12
3.7. Application of pesticide	12
3.8. Sampling strategy and technique	12
3.9. Data collection method and procedures	13
3.9.1. Objective one: Determine the effect of <i>Emamectin benzoate 5.7%</i> and <i>Emamectin benzoate 5%</i> on the level of infestation and severity damage of fruit borer on tomatoes	13
3.9.2. Objective two: Determine variation in the yield and yield components of tomato plants treated with <i>Emamectin benzoate 5%</i> and <i>Emamectin benzoate 5.7%</i> against tomato fruit borer.	14
3.10 Data management, analysis and interpretation	14
4.0 RESULTS	15
4.1 Variation in the level of infestation and severity of damage of tomato fruit borer on the tomato plants across the treatments per location across the two seasons	15
4.3. Variation in the yield and yield components, damage fruits, and percentage losses of the tomatoes across the treatments and location for the two seasons (2022A and 2022B)	18
4.4. Trends of the percentage infestation, severity/damage, and percentage reduction in infestation level and damage across the four fruit development stages	22
CHAPTER FIVE	25
5.0. DISCUSSION OF RESULT	25
CHAPTER SIX	27
6.0. CONCLUSION AND RECOMMENDATIONS	27
6.1. CONCLUSION	27
6.2. RECOMMENDATIONS	27
REFERENCES	28
APPENDICES	x
APPENDIX 1: PHOTOS	x
APPENDIX 2: GENERAL ANOVA TABLE FOR THE PARAMETERS	xi
APPENDIX 3: DATA SHEET ONE	xii
APPENDIX 4: DATA SHEET TWO	xiii

LIST OF TABLES AND FIGURES

LIST OF TABLES

Table 1: The average percentage infestation and severity of tomato fruit borer on the tomatoes at Arapai for season 2022A and 2022B	17
Table 2: The average percentage infestation and severity of tomato fruit borer on the tomatoes at Bulegeni for season 2022A and 2022B	18
Table 3: The yield and yield components of tomato planted at Arapai in Soroti district	20
Table 4: The yield and yield components, weight of damaged fruits, and percentage loss of tomatoes at Bulegeni Satellite station in Bulambuli district for 2022A and 2022B	21
Table 5 shows the general ANOVA	xi

LIST OF FIGURES

Figure 1: Experimental layout.....	11
Figure 2 shows the trend of percentage infestation across the fruiting stages at Arapai Soroti.....	22
Figure 3 shows the trend of percentage severity across the fruiting stages at Arapai Soroti	22
Figure 4 shows the trend of percentage infestation across the fruiting stages at Bulegeni Bulambuli	23
Figure 5 shows the trend of percentage severity across the fruiting stages at Bulegeni Bulambuli	23
Figure 6 Healthy tomato plant.....	x
Figure 7 Infested plant.....	x
Figure 8 Examining the damages on the plant	x
Figure 9 Different damages cauS.e. by the fruit borer on the tomato fruits	x
Figure 10 Pest boring the tomato fruit.....	x
Figure 11 data collection.....	x

LIST OF ACRONYMNS

ANOVA	Analysis of Variance
AUDPC	Area under Disease Progress Curve
BuGIZARDI	Buginyanya Zonal Agricultural Research Development Institute
CCRP	Collaborative Crops Research Project
CV	Coefficient of Variation
EB5	Emamectin Benzoate 5%
EB5.7	Emamectin benzoate 5.7%
FAAS	Faculty of Agriculture and Animal Science
FAO	Food and Agricultural Organization
LSD	Least Significant Differences.
RCBD	Randomized Complete Block Design
SAS	Statistical Analysis System
SSA	Sub Saharan Africa

ABSTRACT

In Uganda, average tomato yield is 4,846.3 kg/acre lower than the potential yield of 6000kg/acre mainly due to attack by various insects-pests including fruit borer, which is one of the most serious pests responsible for the yield gap of 12 ton ha⁻¹. Majority of farmers, about 97.5% use chemical sprays (pesticides) to manage the pest. However, the unselective use of synthetic chemical pesticides to control this pest often result in development of insecticide resistance which can be overcome by rotating the chemicals. One of such chemicals is *emamectin benzoate* containing pesticides that have been found to be useful in the control related insect pests but has however, never been tested under Ugandan conditions. To prove this, field experiments were conducted in Soroti at Busitema University Arapai Campus, and Bulegeni farm a satellite of BugiZARDI during the period April to August 2022 to evaluate the efficacy of different rates of BENTIL (emamectin benzoate 5.7%) compared with PORCELENE (emamectin benzoate 5%) against *Helicoverpa armigera*, the major insect pests of tomato. At both sites the treatments included BENTIL at three levels (5g/20ltr, 10g/20ltr, and 15g/20ltr), and PORCELENE (20g/20ltr) used as Positive control. Plots with no treatments were used as negative control. The treatments were applied thrice at 10 days interval from flowering to maturity i.e. at early, mid and late fruiting stages parameters collected were infestation, severity, yield parameters like number of flowers and flower buds, and the yield weight. The experimental results showed that BENTIL at a rate of 15g/20ltr of water gave the best result with low infestation levels, low severity percentage and registered the highest yield per acre followed by the PORCELENE and BENTIL 10g and there was variation in results in Soroti and Bulambuli. On the other hand the negative control showed the highest level of infestation, severity levels and with the least yield per acre. Conclusively based on the results EB5.7 had great impact on the management of the pest and specifically 15g EB5.7, based on the performance is commended.

CHAPTER ONE

1. INTRODUCTION

1.1. Background

Vegetables and fruits are major crops grown in many districts of Uganda and are produced by mainly smallholder farmer scattered in the country though the detailed data for Uganda's vegetable and fruits are limited (FAO, 2018). Tomato *Lycopersicon esculentum* that belongs to the *Solanacea* family is one of the important fruit vegetables cultivated widely in Uganda (Isaac et al., 2021). It is an herbaceous, usually sprawling plant of the nightshade family cultivated for its edible fruit. This scientific species name *Lycopersicon* means "wolf peach", which comes from German werewolf myths (Reade et al., 2013). Tomatoes are present in different shapes, sizes and color with different brix or sugar levels, and have a high lycopene content, which has numerous health benefits (Reade et al., 2013). Tomato fruits also contains great quantity of water, vitamins (B and C), and minerals, essential amino acids, sugars and dietary fibres, iron and phosphorus with low amounts of proteins and fats (Reade et al., 2013).

In Uganda, tomato is one of the greatest and commonly grown vegetable crop, and is popular in the diets of Ugandan populations. Tomato is grown mainly by farmers who own 2 ha or less of land (Karungi et al., 2011). It contributes about 250USD per hectare to a farm income in Uganda in every growing season at yields of 7.125 tones (Tusiime et al., 2019). Most of the crop grown in Uganda is widely consumed and sold in domestic markets yet there is increasing cross-border demand due to the increasing populations in the neighboring countries of South Sudan and Congo (FAO, 2018). In spite of these developments, the yields per unit areas has remained low averaging at 4 tons per hectare compared to potential yield of 16 tons per hectare (Gabriel, 2021). The low tomato yield is mainly attributed to both biotic and abiotic factors. The abiotic factors among others are poor agronomic practices and poor varieties cultivated (Gabriel, 2021). While biotic factors are pests and diseases of which diseases like bacterial wilt, early and late blight are the key disease of economic importance. Whereas key pests are mites, invasive leaf miner, and tomato fruit borer which cause significant losses in yield in terms of quality and quantity (Simelane, 2017)

REFERENCES

- Abd-Rabou, S., & Simmons, A. M. (2012). Some cultural strategies to help manage *bemisia tabaci* (Hemiptera: Aleyrodidae) and whitefly-transmitted viruses in vegetable crops. *African Entomology*, 20(2), 371–379. <https://doi.org/10.4001/003.020.0201>
- Abdel-baky, N. F., Alhewairini, S. S., & Bakry, M. M. S. (2019). *EMAMECTIN-BENZOATE AGAINST Tuta absoluta MEYRICK AND Spodoptera littoralis BOISDUVAL LARVAE EMAMECTIN-BENZOATE AGAINST Tuta absoluta MEYRICK AND Spodoptera littoralis BOISDUVAL LARVAE*. December 2020. <https://doi.org/10.21162/PAKJAS/19.8082>
- Adamou, H., Garba, M., Mairo, M. D., Adamou, B., Oumarou, S., Kimba, A., Abou, M., & Delmas, P. (2017). Geographical distribution of the tomato borer, *Tuta absoluta* Meyrick (Lepidoptera : Gelichiidae) in Niger. *Scholars Academic Journal of Biosciences*, 5(2), 108–113. <https://doi.org/10.21276/sajb.2017.5.2.4>
- Bengochea, P., Sánchez-Ramos, I., Saelices, R., Amor, F., Del Estal, P., Viñuela, E., Adán, A., López, A., Budia, F., & Medina, P. (2014). Is emamectin benzoate effective against the different stages of *Spodoptera exigua* (Hübner) (Lepidoptera, Noctuidae)? *Irish Journal of Agricultural and Food Research*, 53(1), 37–49.
- FAO. (2018). National gender profile of agriculture and rural livelihoods - Uganda. Country Gender Assessment Series, Kampala. In *Food and Agriculture Organization of the United Nations* (Vol. 11).
- Gabriel, D. (2021). *PRACTICES AND CONSTRAINTS OF TOMATO PRODUCTION*. 21(2), 17560–17580.
- Herald, K. P., & Tayde, A. R. (2018). Biology and morphology of tomato fruit borer , *Helicoverpa armigera* (Hubner) under Allahabad conditions. *Journal of Entomology and Zoology Studies*, 6(4), 1734–1737.
- HOSSAIN, M. (2017). *ECOFRIENDLY MANAGEMENT OF Bemisia tabaci AND Helicoverpa armigera Hubner IN TOMATO*. <http://archive.saulibrary.edu.bd:8080/handle/123456789/1135>
- Isaac, O., Kiryowa, M., Masika, F., & Ramathani, I. (2021). *Practices and constraints of tomato*

- production among smallholder farmers in Otim A 1 , Masika F 1 , Mundingotto J 3 , Matovu M 2 and I Ramathani I Ddamulira Gabriel * Corresponding author email : ddamuliragab@yahoo.co.uk National Crops Resources Research Institute , Kampala , Uganda National Agricultural Research Laboratories , Kampala , Uganda Kyambogo University Kampala , Kampala , Uganda. March. <https://doi.org/10.18697/ajfand.97.19905>*
- Karungi, J., Kyamanywa, S., Adipala, E., & Erbaugh, M. (2011). Pesticide Utilisation, Regulation and Future Prospects in Small Scale Horticultural Crop Production Systems in a Developing Country. *Pesticides in the Modern World - Pesticides Use and Management*. <https://doi.org/10.5772/17170>
- Kumar, H., & Kumar, V. (2004). *Tomato expressing CryIA (b) insecticidal protein from Bacillus thuringiensis protected against tomato fruit borer , Helicoverpa armigera (H ubner) (Lepidoptera : Noctuidae) damage in the laboratory , greenhouse and field. 23, 135–139. <https://doi.org/10.1016/j.cropro.2003.08.006>*
- Kundu, S. S., Chettri, D., Chatterjee, S., & Mukhopadhyay, A. K. (2018). Evaluation of Novaluron 5.25 % + Emamectin benzoate 0.9 % SC against yellow stemborer (*Scirpophaga incertulas*) on rice. *Journal of Entomology and Zoology Studies*, 6(3), 789–792.
- Mahapatro, G. K. (2014). *EVALUATION OF INSECTICIDAL SPRAYS FOR CONTROL OF TEA MOSQUITO EVALUATION OF INSECTICIDAL SPRAYS FOR CONTROL OF TEA. January 2008.*
- Name, C., Name, S., & Cycle, L. (2021). Pacific Pests , Pathogens and Weeds - Online edition Lettuce Cercospora leaf spot (210). *Lettuce Cercospora Leaf Spot, 210, 2. https://apps.lucidcentral.org/pppw_v10/pdf/web_full/lettuce_cercospora_leaf_spot_210.pdf*
- Of, E., Agronets, C., The, I. N., Of, M., & Yield, T. (2016). *A Thesis Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Science (Agricultural Entomology) in the School of Pure and Applied Sciences of Kenyatta University. October.*
- Olsen, L. G. (2018). Integrated Pest Management in Agriculture. *HortTechnology*, 1(1), 129b – 130. <https://doi.org/10.21273/horttech.1.1.129b>

- Ravi, M., Santharam, G., & Sathiah, N. (2008). *Ecofriendly management of tomato fruit borer , Helicoverpa armigera (Hubner)*. 1(2), 134–137.
- Reade, L., Werner, S. S. D., Stevenson, F. D., Coach, C., Kilbane, J., & Lakin, J. M. (2013). Presented By. *Most*, 77(4), 2–5.
- Russell, D. A., Singh, J., Jadhav, D. R., Surulivelu, T., & Regupathy, A. (1998). *Management of Insecticide Resistant Helicoverpa armigera (Lepidoptera : Noctuidae) in Cotton in India*. 679–688.
- Sajjad, M., Ashfaq, M., Suhail, A., & Akhtar, S. (2011). *SCREENING OF TOMATO GENOTYPES FOR RESISTANCE TO TOMATO FRUIT BORER (HELICOVERPA ARMIGER HUBNER) IN PAKISTAN*. 48(1), 59–62.
- Simelane, S. (2017). *Management of African bollworm (Helicorpa armigera) on tomatoes*.
- Singh, N., Dotasara, S. K., Kherwa, B., & Singh, S. (2017). *Management of tomato fruit borer by incorporating newer and biorational insecticides*. 5(2), 1403–1408.
- Talekar, N. S., Opeña, R. T., & Hanson, P. (2006). *Helicoverpa armigera management: A review of AVRDC’s research on host plant resistance in tomato*. *Crop Protection*, 25(5), 461–467. <https://doi.org/10.1016/j.cropro.2005.07.011>
- Tusiime, S. M., Nonnecke, G. R., Masinde, D. M., & Jensen, H. H. (2019). Evaluation of horticultural practices for sustainable tomato production in Eastern Uganda. *HortScience*, 54(11), 1934–1940. <https://doi.org/10.21273/HORTSCI14277-19>
- Vaneva-gancheva, T. (2018). *Chemical control of Helicoverpa armigera (Hübner) (Lepidoptera ; Noctuidae) in tobacco for seed production*. 24(4), 674–678.
- Wilson, L., Khan, M., & Farrell, T. (2008). *Pest Profile*. 1, 1–4.