

**Tomato Production Practices in
Kirinyaga District and Assessment of
Pest Management Options at
KARI - Thika**

Onyango Irene Awino

**A thesis submitted in partial fulfillment for the award of Master of
Science in Zoology in the Jomo Kenyatta University of
Agriculture and Technology**

2008

DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

Signature Date

Irene Awino Onyango

This thesis has been submitted for examination with our approval as university supervisors:

Signature Date.....

Prof. Linus M. Gitonga
JKUAT, Kenya.

Signature Date.....

Dr. Monicah M. Waiganjo
NHRC-KARI, Kenya

Signature Date

Prof. Rosebella O. Maranga
JKUAT, Kenya.

DEDICATION

I dedicate this MSc. thesis to my late Dad, family and my friend Josephat

ACKNOWLEDGEMENTS

First, I thank the Almighty God for giving me courage and strength during the course of my study, for opening ways for the project, for His sustenance and good health and for His grace and abounding love.

I am indebted to Prof. Gitonga for personally introducing me to Dr. Waiganjo who took me aboard the IPM-CRSP project on development of tomato IPM in the region. Her moral, intellectual as well as financial support throughout the study is greatly appreciated. My sincere gratitude is expressed to Prof. Gitonga and Prof. Maranga for accepting to supervise me, more so, for their advice, suggestions and critical comments that have greatly contributed to the completion of this study. I acknowledge Jomo Kenyatta University of Agriculture and Technology, Zoology department for accepting to register me for the course.

My gratitude is also expressed to the Centre Director, KARI-Thika, Dr. C.N. Waturu for providing me with research field and laboratory facilities. Much appreciation to the support staff at KARI-Thika, Crop Protection section; Joyce, Munene, Kamau, Mwangi and Muhia for their technical assistance, Mr. Wepukhulu for data analysis, Faith Nga'ng'a for printing services, J.J. Anyango and J. Kibaki for professional advice and moral support.

I acknowledge my late dad Moses Nyaoke for encouraging me to take up the course and for giving me a shoulder to lean on when things were tough. I also extend my gratitude to my mum and my siblings for their moral support. My

appreciation goes to all the friends who came out to support me when I needed them especially Josephat and Samwel.

TABLE OF CONTENTS

TITLE	i
DECLARATION	ii
DEDICATION.....	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xii
LIST OF PLATES	xiii
LIST OF APPENDICES	xiv
LIST OF ABBREVIATIONS	xv
ABSTRACT	xvi
CHAPTER ONE	1
1.0 INTRODUCTION AND LITERATURE REVIEW	1
1.1 Tomato crop and the important pests	1
1.2 Damage caused by pests on tomato	3
1.3 Tomato pest management	8
1.3.1 Cultural control	8
1.3.2 Biological control	12
1.3.3 Botanical pesticides	14
1.3.4 Chemical control	16
1.3.5 Integrated pest management	18

1.4	Justification	19
1.5	Problem statement.....	20
1.6	Null hypothesis	20
1.7	Alternative hypothesis	20
1.8	Objectives	21
	1.8.1 Main objective.....	21
	1.8.2 Specific objectives	21
CHAPTER TWO		22
2.0	MATERIALS AND METHODS	22
2.1	Survey on tomato production practices	22
	2.1.1 Survey site description	22
	2.1.2 Methodology	22
2.2	Assessment of tomato pest management options	25
	2.2.1 Site description for field trial experiments.....	25
	2.2.2 Experimental design	25
	2.2.3 Data collection	27
	2.2.4 Data analysis	27
CHAPTER THREE		33
3.0	RESULTS	33
3.1	Survey on tomato production practices	33
	3.1.1 Basic data on the respondents	33
	3.1.2 Land ownership under tomato production	33

3.1.3	Labor incurred on tomato production	34
3.1.4	Inputs used in tomato production, tomato varieties grown and irrigation practices	35
3.1.5	Output from tomato production	37
3.1.6	Record keeping	37
3.1.7	Farmers source of information on tomato production	38
3.1.8	Important arthropod pests of tomato as perceived by farmers in Kirinyaga District	39
3.1.9	Pest control practices	41
	3.1.9.1 Pesticide use	41
	3.1.9.2 Knowledge of pesticide handling	42
3.1.10	Training topics received by the farmers	42
3.2	Field experiments to evaluate pest management options	44
3.2.1	Pest incidence	45
	3.2.1.1 Long rains (Season one)	45
	3.2.1.2 Short rains (Season two)	48
	3.2.1.3 Inter-season pest incidence	49
3.2.2	Beneficial insects	51
3.2.3	Yields obtained	53
	3.2.3.1 Long rains (Season one)	53
	3.2.3.2 Short rains (Season two)	55
	3.2.3.3 Inter-season yields	55

3.2.4	Economic benefits of the evaluated pest control treatments	56
	
CHAPTER FOUR	59
4.0	DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS	59
	
4.1	DISCUSSIONS	59
	
4.2	CONCLUSIONS	68
	
4.3	RECOMMENDATIONS	69
	
5.0	REFERENCES	70
	

LIST OF TABLES

Table 3.1	Activities carried out in tomato production and the average cost of hired labor per season per acre	35
Table 3.2	Farm inputs and the percentage of farmers that used them in their tomato production	36
Table 3.3	Record keeping practices on production activities by tomato farmers in Kirinyaga District	38
Table 3.4	Farmers' source on information on tomato production in Kirinyaga District	39
Table 3.5	Methods used by farmers to decide when to apply pesticides	41
Table 3.6	Training topics tomato farmers had received and percent respondent	43
Table 3.7	Pest population means across the pest control treatments evaluated in the tomato trials	47
Table 3.8	Pest population means for the beneficial insects observed during the long rains (season one) and short rains (season two) across the treatments	52
Table 3.9	Mean yields (in kg/ha) obtained the long rains (season one) and short rains (season two) across the treatments.....	54

Table 3.10	Economic benefits for pest management options evaluated in the tomato field trials carried out at KARI-Thika.....	58
------------	--	----

LIST OF FIGURES

Figure 2.1	Kirinyaga District, Kenya and its Administrative Divisions ...	24
Figure 3.1	Farmers perception of the arthropod pests that attacked tomato in Kirinyaga District, Kenya	43
Figure 3.2	Comparisons of mean pest populations observed during the long rains (season one) and the short rains (season two) of the field experiments	35
Figure 3.3	Comparisons of yields obtained during the long rains (season one) and the short rains (season two) of the field experiments	56

LIST OF PLATES

Plate 1.1	Green peach aphids (<i>Myzus persicae</i>)	3
Plate 1.2	Damage by African boll worm (<i>H. armigera</i>) on green tomato fruit	5
Plate 1.3	Webbing caused red spider mites (<i>Tetranychus sp.</i>) on tomato	6
Plate 1.4	Adults whiteflies (<i>Bemisia tabaci</i>) on a tomato leaf	7
Plate 2.1	Tomato field experiment layout at KARI-Thika, 2007 Showing mulched and staked tomato crop	26
Plate 2.2	Mulched treatment	28
Plate 2.3	Untreated control	29
Plate 2.4	Farmers' practice	30
Plate 2.5	Staked with need-based pest control using biopesticides	31

LIST OF APPENDICES

Appendix	I	Survey questionnaire	62
Appendix	II	Weather data	70

LIST OF ABBREVIATIONS

AVRDC	Asian Vegetable Research and Development Centre
TSWV	Tomato Spotted Wilt Virus
TCSV	Tomato Chlorotic Spot Virus
ATTRA	Appropriate Technology Transfer for Rural Areas
TYLCV	Tomato Yellow Leaf Curl Virus
Bt	<i>Bacillus thuringiensis</i>
IPM	Integrated Pest Management

ABSTRACT

A study was carried out on tomato production practices in Kirinyaga District and assessment of pest management options at KARI - Thika. The study endeavored to establish farmers' knowledge on tomato pests and their pest management practices, and to evaluate pest management options. The aim of the study was to come up with an integrated pest management strategy for tomato. The tomato production practices were studied through a survey which entailed interviewing tomato farmers in Kirinyaga District. While assessment of pest management options were done through tomato trials conducted at KARI-Thika. A structured questionnaire was used in the survey and only farmers who had been involved in tomato production for at least the past six months were each randomly administered with a questionnaire. Tomato field trial experiments were laid on randomized complete block design with five pest control treatments replicated four times. The pest control treatments were; mulch with no pest control option; untreated control; mulch with need-based pest control using biopesticides; farmers' practice with regular pest control and staking with need-based pest control using biopesticides. Disease control and other agronomic practices were conducted regularly on all the treatments. Pest incidence was recorded once in a week throughout the crop season. Harvested tomatoes were weighed and converted into yield/ha for all the treatments. The trials were conducted during the long and the short rains. One hundred and twenty farmers were interviewed during the survey. It emerged that pests and diseases were a constraint in tomato

production. Some of the pests mentioned included spider mites, African bollworm, thrips, aphids and whiteflies while the diseases included late and early blight, bacterial wilt, tomato spotted wilt virus, leaf curl virus, powdery mildew, blossom end rot and nematodes. Farmers used pesticides in pest management and they had little or no knowledge on alternative pest management and IPM. The pests observed in the field trial experiments were whiteflies, aphids, thrips, spider mites, leaf miners and African bollworms, while the beneficial insects observed were the ladybird beetles and spiders. Pest incidence varied within pest control treatments in both crop seasons at $p < 0.0001$. The mean marketable yield in the long and short rains differed significantly within treatments in both seasons at $p < 0.0001$. Farmers' practice which involved routine pesticide use had the lowest mean pest incidence and highest mean marketable yield in both seasons. The short rains had higher pest incidence and lower yields compared to the long rains. Treatments with mulch and where biopesticide application was used had low whiteflies population. Routine pesticides applications as well as poor weather conditions increased pest management costs. Farmers needed training on alternative pest management and IPM to reduce reliance on pesticides, reduce costs of pest management and to ensure correct choice and use of fertilizers and pesticides. Mulching reduced the cost of labor on weeding and provided an environment conducive for beneficial insects. Farmers incurred losses due to price fluctuations therefore there was need to put in place appropriate marketing

policies to stabilize prices. Early planting was an important factor to take advantage of good weather and evade pests.