EVALUATION OF SOME RESISTANCE INDUCERS AGAINST THE ROOT-KNOT NEMATODE

BY

AHMED SOLIMAN MOHAMED MOHAMED EL-NUBY

B.Sc. Agric. Sci. (Plant pathology), Fac. Agric., Zagazig Univ., 1995
M.Sc. Agric. Sci. (Nematology), Cairo Univ., 2003

THESIS

Submitted in Partial Fulfillment of
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

In

Agricultural Zoology
(Nematology)

Department of Zoology and Agricultural Nematology
Faculty of Agriculture
Cairo University
EGYPT

2014

APPROVAL SHEET

EVALUATION OF SOME RESISTANCE INDUCERS AGAINST THE ROOT-KNOT NEMATODE

Ph.D. Thesis

In

Agricultural Zoology (Nematology)

By

AHMED SOLIMAN MOHAMED MOHAMED EL-NUBY

B.Sc. Agric. Sci. (Plant pathology), Fac. Agric., Zagazig Univ., 1995
M.Sc. Agric. Sci. (Nematology), Cairo Univ., 2003

APPROVAL COMMITTEE

Dr. MOHAMED FAHMY EISSA ....
Professor of Nematology, National Research Center

Dr. MOSTAFA YOSSEF YASSINE..
Professor of Nematology, Faculty of Agric., Cairo University

Dr. AMIN WAFDY AMIN..
Professor of Nematology, Faculty of Agric., Cairo University

Dr. AL-SAYED ABDEL GHANI ANTER..................................
Professor of Nematology, Faculty of Agric., Cairo University

Date: 1 / 1 /2015

SUPERVISION SHEET

EVALUATION OF SOME RESISTANCE INDUCERS AGAINST THE ROOT-KNOT NEMATODE

Ph.D. Thesis

In

Agricultural Zoology (Nematology)

By

AHMED SOLIMAN MOHAMED MOHAMED EL-NUBY

B.Sc. Agric. Sci. (Plant pathology), Fac. Agric., Zagazig Univ., 1995
M.Sc. Agric. Sci. (Nematology), Cairo Univ., 2003

SUPERVISION COMMITTEE

Dr. AL-SAYED ABDEL GHANI ANTER
Professor of Nematology, Faculty of Agric., Cairo University

Dr. AMIN WAFDY AMIN
Professor of Nematology, Faculty of Agric., Cairo University

Dr. AZZA HASHEM ASHOUB
Professor of Nematology, Desert research Center.

Name of Candidate: Ahmed Soliman Mohamed Mohamed El-Nuby **Degree:** Ph.D.
Thesis Title: Evaluation of some resistance inducers against the root-knot nematode
Supervisors: Dr. Al-Sayed Abdel Ghani Anter
Dr. Amin Wafdy Amin
Dr. Azza Hashem Ashoub
Department: Zoology and Agricultural Nematology **Branch:** Nematology
Approval: 1/1/2015

ABSTRACT

This study was carried out to evaluate some biotic and abiotic agents as inducers for tomato resistance against the root-knot nematode, *Meloidogyne incognita.* These agents included rhizobacteria, chemical activators and also some growth regulators.

Results showed that thirty five bacterial isolated processed the ability to kill nematode juveniles (J_2) with various degrees. Serial screenings were done till selecting ten species defined as; *Bacillus brevis, B. cereus, B. firmus*, *Klebsiella planticolla*, *Lactobacillus agilis*, *L. fermentum*, *Methylomonas methanica, Neisseria elongate*, *Obesumbacterium proteus* and *Pseudomonas aeruginosa*, which achieved highly reduction% (R) in nematode build-up. The more effective four species were *M. methanica*, *B. cereus, O. proteus* and *B.brevis* while they recorded 93.20%, 89.25%, 87.66% and 87.74% (R) in total population. The ten species showed nematicidal activity against nematode (J_2) and also inhibited egg hatch. These species were able to suppress nematode population and improving tomato plant growth. Split-root technique indicated that these species could suppress nematode via induction of systemic resistance (ISR), also elevation of peroxidase (POX) and polyphenol oxidase (PPO) activities as well as total phenolic content in tomato roots presented other indicators for occurring ISR. On such four vigorous species, the most effective bacterial form was crude suspension (cells&metabolites), also the ability of dead cell to suppress nematode population proved capability of these bacteria to ISR. Some nematoxic compounds were extracted form such highly effective bacteria. Positive impact of these bacteria on nematode also showed through diminished of giant cell area and gall area and weight. The positive impact of highly effective bacterial species on plant growth and mineral content was observed. Concerning abiotic inducers, eight chemicals (acetyl salicylic acid, β-aminobutyric acid-BABA-, ascorbic acid, 2,6-dichloroisonicotinic acid, chlorosalicylic acid-CSA-, nitrosalicylic acid-NSA-, salicylic acid-SA- and selenium) cloud killed (J_2). Their mixture showed synergetic effect in most cases to killing (J_2) as well. Adding chemical 3 days before inoculation was more effective than simultaneous and after inoculation. Double dose was more effective than one or three when considering adverse impact on plant growth. Combination between pre and post application was proper method for supplying chemicals and achieving (%R) than pre-inoculation only. POX and PPO activities in chemical-tomato roots were elevated compared with controls. The most effective chemicals were CSA, NSA, BABA and SA which achieved the maximum reduction in population density; 57.6%&84.01%; 56.5%&81.8%; 55.45%&79.4% and 54.5%&78.3% in both pre and pre&post-inoculation respectively. Mixing between most effective bacterial species and chemicals showed small synergetic effect in killing (J_2) and in vivo inhibitory effect with few exceptions (SA+*B.cereus*). Growth regulators (GRs) selected from screening (suppressed nematode reproduction, while the highly suppressive effect in total population recorded by prop, gibberellic acid, biohorme and benzyl adenine (67.27%, 63.82%, 61.67% and 60.1%), tomato plant growth positively reacted with GRs. Enzyme activities also increased in GRs-treated tomato roots. Prop was the most effective to increase POX, PPO and superoxide dismutase activities as well as total phenolic content. Gall area and weight were ceased in most GRs except in amocton and ethephon. Mineral content in tomato plant was peaked with prop treatment. It is concluded that, four rhizobacterial strains and four chemical activators besides some GRs especially prop could suppress *M. incognita* reproduction via ISR in tomato plants and can involved in integrated nematode management program.

Key word: *Meloidogyne* spp, induced resistance, rhizobacteria, chemical inducers, growth regulators.

ACKNOWLEDGEMENT

*First and foremost, all praise to **Allah,** The Almighty God, without His care nothing could have been achieved.*

*The author wishes to express deepest sincere thanks to **Dr. A. A. Anter** professor of Nematology, Faculty of Agriculture, Cairo University, for his supervision, guidance, encouragement during the research phase, reviewing the manuscript and constructive criticism during this work.*

*The author also likes to express my deepest gratitude thanks to **Dr. A. W. Amin** professor of Nematology, Faculty of Agriculture, Cairo University, for their supervision, preparation the manuscript, guidance, support and facilities offered by him through this study.*

*I would like to express my deepest thanks to **Dr. A. H. Ashoub** professor of Nematology, Desert Research Center, for their supervision, preparation the manuscript, guidance and solving troubles during this work.*

*I also like to express my deepest gratitude and sincere appreciation to **Dr. Khaled Ismail Zaki,** head of ecology and dry land cultivations division, Desert Research Center, for his sincere support.*

*I wish to express my gratefulness to all team in plant protection Department, Desert Research Center, for help me. Special thanks to **Dr. Mohamed Abdel Aziz Balah** for his support and help in the part of extraction and purification of nematoxic compounds.*

*The author offers their deep thanks for all the members of the central lab, Desert Research Center, (especially for **Mrs. Nehad Mohamed Fathy**) for her sincere help.*

CONTENTS

INTRODUCTION

Root-knot nematodes (RKN); *Meloidogyne* spp. constitute the major nematode problem in developing countries. About 2000 plants species are susceptible to their infection and they cause approximately 5% of global crop loss (Hussey and Janssen, 2002). The most common species is *M. incognita* (Kofoid and White) Chitwood, which causes considerable losses in many crops (Lamberti, 1997). *Meloidogyne* spp. can be managed by cultural practices, resistant cultivars and chemical nematicides, which considered one of the primary means of control for Root-knot nematodes but are mostly inappropriate for subsistence farmers in developing countries (Ahmed *et al.*, 2013).

Tomato (*Lycopersicon esculemtun* Mill.) is the world's largest vegetable crop and known as protective food both because of its special nutritive value and also because of its wide spread production, which come second to potato with annual world production of about 161.3 million ton and in Egypt reached to 8.6 million ton in 2012 (FAOSTAT, 2012). As it is a short duration crop and gives high yield and it is economically important for the economic point of view and hence area under cultivation is increasing day by day. Tomato is one of the most important commercial and widely grown vegetable crops in both tropics and sub- tropics, which is often severely attacked by root-knot nematode, *Meloidogyne incognita*, a predominant and widely prevalent species inflicting serious loss in tomato (Sasser, 1990). A yield loss of 35.0-39.7 percent has been reported due to root-knot nematode infestation (Reddy, 1985 and Jonathan *et al.*, 2001).