



UNIVERSITI PUTRA MALAYSIA

***PREVELANCE AND PATHOGENICITY OF ROOT LESION NEMATODE,
Pratylenchus spp. ON BANANA (Musa paradisiaca L.) IN PENINSULAR
MALAYSIA***

ADAMU SAIDU PAIKO

FP 2016 25



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MALAYSIA**

By

ADAMU SAIDU PAIKO

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

May 2016

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DEDICATION

This work is dedicated to my beloved parents; late mother Mallama Jummai Ibrahim, my father Alhaji Adamu Saidu Jazu and my bestowed kids; Abdullah, AbdurRahman, Isah and young Mus'ab.



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Degree of Master of Science

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May 2016

Chairman : Associate Professor Kamaruzaman Bin Sijam, PhD
Faculty : Agriculture

Root lesion nematode (*Pratylenchus* spp.) cause considerable damage to banana plant (*Musa* spp.) globally. Even though, it has been reported in Malaysia, its disease prevalence and severity of infection has not been attended to. The objective of the research therefore, was aimed at determining the disease prevalence of *Pratylenchus* spp. and the status of their damage on *Musa* spp. in Peninsular Malaysia. To study the prevalence and pathogenicity of root lesion nematode, *Pratylenchus* spp. on banana (*Musa paradisiaca*) in Peninsular Malaysia, samples of soil and root were collected from banana fields nationwide in 2014. Of the 13 sampled banana fields, lesion nematodes were found in 10 fields (76% of the areas surveyed). Rating of root cortex occupied by reddish brown lesion was significant among all the states, with Johor having the highest disease severity of 36.3% followed by Selangor 20.7%, Perak 20.2% and Pahang 20.4 % respectively. The study found that all the sampled areas have exceeded threshold limit, which is 5%. Mean population density of fields having *Pratylenchus* spp. from 20 g roots and 200 g soil were significantly different, where population mean of Selangor, (root= 838 and soil= 897), (root= 18,050 and soil= 13,056) in Johor, (root= 2341 and soil= 461) Perak and (root= 11,315 and soil= 7,199) Pahang were recorded. Other plant-parasitic nematodes identified were *Rotylenchulus* spp., *Meloidogyne* spp., *Helicotylenchus* spp., *Hoplolaimus* spp. and *Radophulus similis*. Pathological reaction of *P. coffeae* against banana cultivar berangan (*Musa paradisiaca*) multiplications was observed after 12 weeks of growth. There were significant differences in vegetative growth within the various pathogens inoculation levels evaluated. Multiplication factors ranged between 1.6-4 in *P. coffeae*. Reduction in root length (-23.68 to -84.95), shoot length (-13.11 to -45.80), root weights (-21.30 to -99.85) and shoot weight (-9.30 to -61.62) lengths were recorded at ($P \leq 0.05$) level of probability. Banana cultivar berangan showed high level of susceptibility through the activity of polyphenol oxidase and peroxidase-induced resistance at all days after inoculation with *P. coffeae* compared to the control, except at week 12 where it declined or non-significant with the control. Our observations from this study, revealed that *P. coffeae* is among the most damaging plant-parasitic nematode species associated with banana in Peninsular Malaysia replacing *R. similis*, which is seldom reported or

localized to a particular area and in low densities, followed by *Meloidogyne* spp. That it is common on banana cultivar berangan in this country, and that its geographical distribution is not restricted. Although the morphological study of the female populations of *P. coffeae* from Peninsular Malaysia gave some little variation in morphology from the reference sources, we resolved that these variations are within the range of the previously described morphological variations in *P. coffeae* populations from other parts of the world, thus, confirming that the isolates were *P. coffeae*. In general, the glass house pathogenicity trial of *P. coffeae*, suppresses vegetative growth of the banana cultivar berangan significantly. Root lesion indexes showed higher disease severity at all inoculum levels evaluated. It can be concluded that *P. coffeae* is widely distributed and caused significant damage to banana crop in Peninsular Malaysia.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk Ijazah Master Sains

**KEJADIAN DAN PATOGENISITI NEMATODA LESI AKAR, *Pratylenchus* spp.
PADA PISANG (*Musa paradisiaca* L.) DI SEMENANJUNG MALAYSIA**

Oleh

ADAMU SAIDU PAIKO

Mei 2016

Pengerusi : Profesor Madya Kamaruzaman Bin Sijam, PhD
Fakulti : Pertanian

Nematoda lesi akar (*Pratylenchus* spp.) menyebabkan kerosakan yang signifikan pada tanaman pisang (*Musa* spp.) di dunia. Walaupun ianya telah dilaporkan di Malaysia, namun kejadian dan keparahan jangkitan masih tidak dapat dihindari. Objektif kajian ini adalah untuk menentukan kejadian penyakit oleh *Pratylenchus* spp. dan status kerosakannya pada *Musa* spp. Bagi menentukan kejadian dan kepatogenan nematoda lesi akar, *Pratylenchus* spp. pada *Musa* spp. di Semenanjung Malaysia, sampel tanah dan akar telah diambil daripada kebun pisang di seluruh negara pada tahun 2014. Daripada 13 kebun pisang yang disampel, nematod lesi akar telah ditemui di 10 kebun (76% daripada jumlah kebun pisang yang disampel). Bahagian korteks akar dengan luka coklat kemerahan adalah ketara dalam kalangan semua negeri, di mana Johor mempunyai tahap keparahan jangkitan tertinggi iaitu sebanyak 36.3%, diikuti oleh Selangor, 20.7%, Perak dan Pahang, masing-masing 20.2% dan 20.4%. Kajian ini mendapati bahawa semua kawasan pensampelan melebihi had ambang, iaitu 5%. Min densiti populasi kebun yang dijangkiti dengan *Pratylenchus* spp. daripada 20 g akar dan 200 g tanah berbeza secara ketara di mana min populasi di Selangor, (akar = 838 dan tanah = 897), (akar = 18,050 dan tanah = 13,056) di Johor, (akar = 2341 dan tanah = 461) Perak dan (akar = 11,315 dan tanah = 7,199) Pahang telah direkodkan. Nematod parasit tumbuhan lain yang dikenalpasti ialah *Rotylenchulus* spp., *Meloidogyne* spp., *Helicotylenchus* spp., *Hoplolaimus* spp. dan *Radophulus similis*. Reaksi patologi *P. coffeae* terhadap pisang kultivar berangan (*Musa paradisiaca*) menunjukkan pengurangan selepas 12 minggu pertumbuhan. Terdapat perbezaan yang ketara dalam pertumbuhan vegetatif dalam patogen dan antara pelbagai peringkat inokulasi yang telah dinilai. Kadar pengurangan berada antara 1.6-4 pada *P. coffeae*. Pengurangan dalam panjang akar (-23.68 kepada -84.95), panjang pucuk (-13.11 kepada -45.80), berat akar (-21.30 kepada -99.85) dan berat pucuk (-9.30 kepada -61.62) telah direkodkan pada $P \leq 0.05$. Pisang kultivar berangan menunjukkan kerentanan yang tinggi melalui aktiviti rintangan berasaskan 'polyphenol oxidase' dan 'peroxidase' pada semua hari selepas inokulasi berbanding kawalan, kecuali pada minggu ke-12 di mana ia telah mengalami penurunan atau tidak ketara berbanding kawalan. Pengamatan kami daripada kajian ini, mendedahkan bahawa *P. coffeae* adalah di antara nematoda parasit tumbuhan yang sangat merosakkan berkaitan dengan pisang di Semenanjung Malaysia menggantikan *R. similis* yang mana jarang dilaporkan atau terhad pada sesuatu kawasan dan mempunyai

kepadatan rendah seterusnya diikuti dengan *Meloidogyne* spp. Fenomena ini adalah lazim pada pisang kultivar berangan di negara ini dan taburan geografinya adalah tidak terbatas. Walaupun kajian morfologi pada populasi betina *P. coffeae* daripada Semenanjung Malaysia menunjukkan hanya sedikit variasi pada morfologinya berbanding sumber rujukan, kami memutuskan variasi ini adalah di dalam jarak variasi morfologi pada populasi *P. coffeae* sebagaimana yang telah dijelaskan sebelum ini kawasan lain di dunia, seterusnya mengesahkan bahawa solat-solat tersebut adalah *P. coffeae*. Umumnya ujian patogenisiti *P. coffeae* di rumah kaca, berupaya menekan pertumbuhan vagitatif pisang kultivar berangan dengan ketaranya. Indek lesi akar menunjukkan keparahan penyakit yang tinggi pada semua tingkat inoculum yang dinilai. Dapat disimpulkan bahawa *P. coffeae* telah luas tersebar dan menyebabkan kerosakan yang signifikan terhadap tanaman pisang di Semenanjung Malaysia.

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I certify that a Thesis Examination Committee has met on 03 May 2016 to conduct the final examination of Adamu Saidu Paiko on his thesis entitled "Prevalence and Pathogenicity of Root Lesion Nematode, *Pratylenchus* spp. on Banana (*Musa paradisiaca* L.) in Peninsular Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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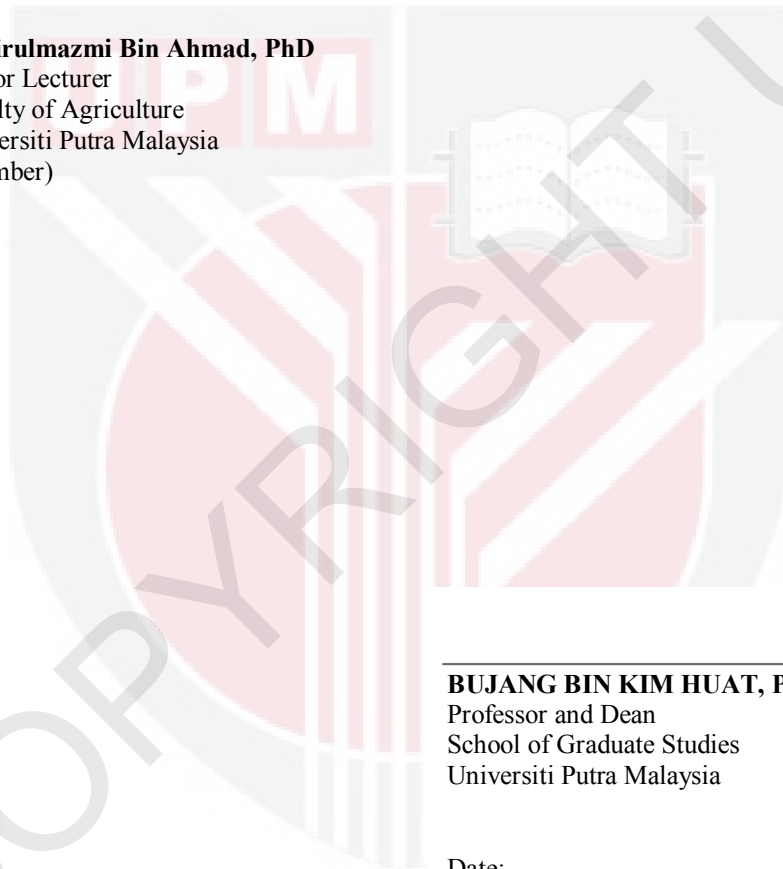
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CHAPTER 1

INTRODUCTION

1.1 Background

Banana is the world's most prominent fruit and also among the major staple foods, alongside, wheat, maize and rice. About a hundred and seven million metric tons of bananas were produced in 2011, across more than 130 countries covering an area of about 0.1 per cent of the agricultural area utilized in the world (Agritrade 2013). Food and Agriculture Organization of United Nations (FAO) (2013) estimated the exchange value to be around US\$9 billion and a trade value of about US\$25 billion. Over 1,000 cultivars of the bananas have been identified worldwide (Heslop-Harrison and Schwarzacher 2007). In the Malaysian scenario, it has been recognized as the second most commonly grown fruit crop after durian, with a cultivated area of about 29,000 ha and production of 530,000 metric tonnes, which amount to \$24 million (Tengku et al, 2011). Johor, Sabah and Sarawak served as major states producing banana covering 27,543 hectares in 2009. Pisang berangan and the Cavendish cultivars cover almost 50% of the banana growing land, while the remaining land are cultivated with other prominent cultivars like; Pisang Mas, Pisang Abu, Pisang Nangka, Pisang Rastali, Pisang Awak, Pisang Tanduk and Pisang Raja (Tengku et al, 2011). about 12% of the bananas produced in Malaysia, are mainly exported to Middle East, Brunei, Hong Kong, and Singapore, while remaining which are mostly cultivated by smallholders are consumed locally.

Banana suffers from many diseases caused by fungi, bacteria, viruses and nematodes (Jones, 2000). The pathogens that cause these diseases vary in the amount of damage they cause with some having very minor effects while others are extremely serious and can kill the plant. Amongst the various pathogens infecting the banana plants, the nematodes infestation is of the prime importance, causing an annual yield loss of approximately 20% (De Waele and Elsen, 2007). The parasitizing of banana by Burrowing nematode is a worldwide phenomenon. In addition, diseases like Fusarium wilt, sigatoka and blood disease have threatened banana production in Malaysia, leading to decreased in output. Another factor seen as a threat is high costs of labour and marketing problems (Abdul Rahman et al., 2014).

Nematodes with an estimated population of about a million species are diverse metazoans (Lambhead, 2004). They form part of almost all ecosystems as consumers of dissolved and particulate organic matter, parasite of plants and animals, bacterivores and herbivores. They are believed to be the most abundant in soil and aquatic sediments. McCarter (2009) put an estimated global loss of \$118 billion for 2001, resulting from their impact on crop of which almost half was linked to only two crops; maize and rice. This showed paucity study of their kind, pointing to only 26,000 (estimated < 3%) species studied to date (Hugot et al., 2001; Hallan, 2007). The crops damage from plant parasitic nematodes are agro-climatic conditions dependent, host susceptibility, pathogenicity and other climatic factors (Queneherve, 2009). The impacts of nematode infestation on banana plants are often asymptomatic, owing to the possession of thick root epidermis or recognized at very

advance stage of disease, and the farmers has no option rather than the gross removal of the plant (Abdul Rahman et al., 2014). (PPN) infection on bananas make water up take and nutrients by the host plant less, causing maturation to be delayed, stunting and reduction in bunch size. Level of the damage may differ from vegetative period slightly extended to the emergence of symptom of attack by lesion nematode, which causes the plant to topple. Geographical locations determine the effect of a community of PPN damages on crop (Quénéhervé, 2009). Damage caused by PPNs is like the damage caused by any other pests or parasites, and is influenced by the conditions of environment, host susceptibility, and nematode pathogenicity. There are only few reports on the prevalence of nematodes in Malaysia and also there is inconsistency and knowledge gap regarding the occurrence and prevalence of nematodes. In the past few decades few research work or survey have been done and a very little information is available about the infestation of nematodes and their damage on fruit crops (Sidam and Bilal Mat, 1983; Abdul Rahman et al., 2014).

The most important agriculturally group of nematodes, following cyst nematodes (*Heterodera* and *Globodera*) and root knot nematodes (*Meloidogyne* spp.) are the genus *Pratylenchus*, the root lesion nematodes (Davis and MacGuidwin 2000). Root lesion nematode (*Pratylenchus* spp.) cause considerable damage to banana plant (*Musa* spp.) globally. In Malaysia, it has been reported as one of the damaging species in a study conducted by Abdul Rahman et al., (2014) on distribution of plant parasitic nematodes in Peninsular Malaysia, however, their damaging status has not been defined.

1.2 Justification of study

There are only few reports available or work done in the past on the persistence of nematodes in general, lesion nematodes in particular on the banana cultivated areas. Therefore, it is highly desirable to conduct a research on the population distribution of root lesion nematode, *Pratylenchus* spp. and level of their infestation for management of their diseases in banana cultivated areas in Malaysia. Since condition favorable for root lesion nematode survival is found in Malaysia, and the idea of the species involved will be important to future breeding efforts, this project was undertaken.

1.3 General objective

The main objective of the present research work was to investigate the prevalence of *Pratylenchus* spp. infestation in banana (*Musa* spp.) and assessment of their disease severity in the Peninsular Malaysia.

1.3.1 Objectives

Considering the above points, the studies were conducted with the following objectives:

- (1) To investigate disease prevalence and identification of root lesion nematodes among banana acreage in Peninsular Malaysia

- (2) To determine the pathological reaction and damaging population level of *Pratylenchus spp.* on banana cultivar berangan.



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