UNIVERSITI PUTRA MALAYSIA

THE DISTRIBUTION, DAMAGE AND CONTROL OF THE ROOTKNOT NEMATODE, MELOIDOGYNE INCOGNITA (KOFOID AND WHITE) CHITWOOD ON TOBACCO IN MALAYSIA

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FP 1988 8

THE DISTRIBUTION, DAMAGE AND CONTROL OF THE ROOT-KNOT NEMATODE, *MELOIDOGYNE INCOGNITA* (KOFOID AND WHITE) CHITWOOD ON TOBACCO IN MALAYSIA.

BY

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A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy in the Faculty of Agriculture, Universiti Pertanian, Malaysia.

August 1988

ACKNOWLEDGEMENTS

In the name of Allah, the merciful, the compassionate. I would like to express my gratitude to the Director-General of Malaysian Agricultural Research and Development Institute (MARDI), Dato' Dr. Mohd Yusof Hashim for approving the study to be carried out and to use facilities and manpower in implementing the study.

I am very thankful to my supervisor, Associate Professor Dr. Abd.Rahman Razak from Universiti Pertanian Malaysia, who offered me guidance and advice during planning of experiments, analysis of data and writing of the thesis.

To many supporting staff of MARDI, I appreciate so much of their dedicated support and help. With these, many experiments became much easier to handle. Among the staff, I like to record my thanks to Mohd.Zaidun Bilal Mat who has been working with me all these years since 1974. I am also grateful to others, including Affendi, Nasir, Othman, Nor Rijam, Rasli, Aini Khatijah, Jami'ah Ismail, Arbaeyah, and Syed Abas who had helped me in various stages of the study. To Salbiah and Zaharah, I am grateful for their advice on experimental design and analysis of data.

Finally, my wife Halidzah and the three children, Hezerul, Azila and Amalina Asyikin, deserved special mention because of their patience during the study especially during my one and half year stay in Kelantan.

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ABSTRACT

An Abstract of the thesis submitted to the Senate of Universiti Pertanian Malaysia as a partial fulfilment of the requirements for the degree of Doctor of Philosophy.

Title: The Distribution, Damage, and Control of the Root-knot Nematode, Meloidogyne incognita (Kofoid and White) Chitwood on Tobacco in Malaysia.

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Year: 1988

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The present study attempts to map the distribution of Meloidogyne species in Kelantan, establish the pathogenecity of M.incognita on tobacco and to find out suitable control methods of the nematode on tobacco.

Nematode survey showed that ten plant-parasitic species were associated with tobacco in Kelantan. The nematode species were Meloidogyne incognita, M.javanica, Helicotylenchus crenacauda, Rotylenchulus reniformis, Macroposthonia ornata, Pratylenchus zeae, Xiphinema citri, X.radicicola, Tylenchorhynchus annulatus, and Hirschmanniella

mucronata.

The root-knot nematode, *Meloidogyne* species, was more abundant in soil at Bachok than at Pasir Putih, Pasir Mas and Tumpat. *M.incognita* was found to belong to biological race 2 while no race was identified in *M.javanica* populations.

During tobacco season, the populations of *Meloidogyne* species increased to a peak level in May and then decreased in August. After the tobacco season, the populations increased again to another level in October. This population level was lower than the peak in May. The root-knot nematode was found to parasitize weed species such as *Amaranthus* sp and *Cleome rufidosperma*.

Artificial inoculation experiments established that *M.incognita* reduced the growth, yield and quality of tobacco cv Mc Nair 14. Multiple inoculations of *M.incognita* larvae on tobacco at sowing, polybag and field stage produced cumulative effects on growth, yield and quality. Tobacco plants with triple inoculations had the lowest leaf number, total leaf area and dry weight of stem as compared to those of uninoculated control, single and double inoculated plants.

Efficacies of control measures on the root-knot nematode were variable. In the polybag, dazomet, carbofuran, methyl bromide, fenamiphos and *Paecilomyces lilacinus* encouraged early growth of tobacco seedlings but not the yield. In the field, methyl bromide encouraged growth and yield, and reduced nematode populations but leaf quality was affected. Application of methyl bromide both in polybag and field produced similar results. Soil conditions in the field might have affected the efficacy of these control methods because fenamiphos and *P.lilacinus* were found to be effective when applied in pots.

RINGKASAN

Ringkasan tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai sebahagian daripada syarat memenuhi keperluan ijazah Doktor Falsafah.

Tajuk: Taburan , Kerosakan dan Pengawalan Nematod Puru Akar, *Meloidogyne incognita* (Kofoid dan White) Chitwood, pada Tembakau di Malaysia.

Oleh: ABD.KARIM SIDAM

Tahun: 1988

Penyelia: Profesor Madya Dr. ABD. RAHMAN RAZAK

Fakulti: PERTANIAN

Kajian ini bertujuan untuk mengetahui taburan spesies *Meloidogyne* di Kelantan, menentukan kepatogenan *M.incognita* pada tanaman tembakau dan mencari kaedah kawalan yang sesuai.

Survei nematod di Kelantan menunjukkan bahawa 10 spesies parasit tumbuhan telah dijumpai di keliling pokok tembakau. Spesies-spesies itu ialah *Meloidogyne incognita*, *M.javanica*, *Helicotylenchus crenacauda*, *Rotylenchulus reniformis*, *Macroposthonia ornata*, *Pratylenchus zeae*, *Xiphinema citri*, *X.radicicola* , *Tylenchorhynchus annulatus* and *Hirschmanniella ornata*.

Nematod puru akar, spesies-spesies *Meloidogyne*, lebih kerap dijumpai di Bachok, daripada di Pasir Putih, Pasir Mas dan Tumpat. Populasi *M.incognita* dikenalpasti sebagai ras biologi 2, sementara populasi *M.javanica* tidak mengandungi ras.

Pada musim tembakau, populasi spesies *Meloidogyne* naik ke suatu aras puncak pada bulan Mei dan kemudian turun pada bulan Ogos. Selepas musim tembakau, populasi nematod naik lagi ke suatu aras pada bulan Oktober. Aras populasi ini lebih rendah daripada aras pada bulan Mei. Nematod puru akar didapati memparasit rumpai seperti *Amaranthus sp* dan *Cleome rufidosperma*.

Ujikaji suntikan menunjukkan bahawa *M.incognita* mengurangkan pertumbuhan, hasil dan mutu tembakau cv Mc Nair 14. Suntikan berganda larva *M.incognita* pada anak benih tembakau di peringkat semaian, beg plastik dan ladang menghasilkan kesan timbun-tambah kepada pertumbuhan, hasil dan mutu. Pokok tembakau disuntik tiga kali mempunyai bilangan daun, keluasan daun, berat daun awet dan berat batang yang paling rendah jikalau dibandingkan dengan pokok tanpa suntikan nematod, sekali atau dua kali suntikan.

Keberkesanan kaedah kawalan terhadap spesies *Meloidogyne* didapati berbeza-beza. Di dalam beg plastik, dazomet, carbofuran, metil bromida, fenamiphos, dan *Paecilomyces lilacinus* menggalakkan pertumbuhan awal tembakau tetapi tidak membaiki hasil. Di ladang, metil bromida menggalakkan pertumbuhan, hasil dan mengurangkan populasi nematod tetapi menjejaskan mutu daun. Penggunaan metil bromida di dalam beg plastik serta di ladang pun menghasilkan keputusan yang sama. Keberkesanan kaedah kawalan mungkin dipengaruhi oleh keadaan tanah di ladang kerana fenamiphos dan *P.lilacinus* didapati berkesan apabila digunakan di dalam pasu.

CHAPTER 1. INTRODUCTION AND LITERATURE REVIEW

1.1. INTRODUCTION

Tobacco crops are grown in Malaysia by farmers on a relatively small pieces of land, on the average, 0.25 ha per family. There are about 50,000 tobacco growers in Malaysia: 62 % of them are in Kelantan, 17 % in Terengganu with the remaining 21 % of the growers found in other states (Abdullah, 1986).

To maintain root aeration and plant turgidity, tobacco plants must be grown in soils which have open and loose structure with good drainage, such as light sand and sandy loams (Tso, 1972). Unfortunately, these soils are not easily available and thus tobacco is normally grown on less suitable soils namely, (a) coastal plain clay soil (b) granite wash alluvial soil and (c) coarse sandy soil or bris (Anonymous, 1980b). Despite these unfavourable soils, the tobacco acreage has expanded tremendously from the initial 8 ha introduced by Malaysian Tobacco Company at Bachok, Kelantan in 1959 (Teo, 1977) to the current 15,882 ha, in the states of Kelantan, Terengganu, Kedah, Perlis, Pahang, Melaka, Johor and Negeri Sembilan (Abdullah, 1986). Sixty four percent of the total tobacco growing area was situated in Kelantan, 23.3 % in Terengganu, 5.1 % in Kedah, 3.5 % in Perlis and 4 % in other states.

Being a weather-sensitive crop, tobacco yield in this country fluctuates from one year to another. Cultural practices have also influenced the yield. In 1980, 13,238 ha of tobacco was grown and produced 10.5 million kg of cured tobacco leaf at the production rate of 851 kg/ha. In 1986, 15,822 ha of tobacco was grown and produced 13.6 million kg of cured leaf at the rate of 940 kg/ha (Abdullah, 1986). During this period, there was 19.5% increase in cultivated area and 29.5 % increase in total production of cured leaf but only 10.5 % increase in yield per ha. The yield is considered lower than those from major producing countries. For example, tobacco yield in U.S.A. was 2183 kg/ha, 1924 kg/ha in Zimbabwe and 2462 kg/ha in Japan (Tucker, 1982). Furthermore, there is variation in the tobacco yields between various growing areas in this country. The tobacco yield in Kelantan was 614.3 kg/ha, 338.7 kg/ha in Terengganu, 419.1 kg/ha in Pahang, 571.7 kg/ha in Kedah, and 132.3 kg/ha in Negeri Sembilan (Anonymous, 1981).

1.2 VARIETIES OF TOBACCO GROWN IN MALAYSIA

Tobacco belongs to the Solanaceae family and to the genus Nicotiana. The species, N.tabacum L, is the most widely grown for commercial use (Tso, 1972). Genetical evidences suggest that tobacco originated from South America.

<u>N.tabacum</u> is an amphiploid and a hybrid of two species <u>N.sylvestris</u> and <u>N.tomentosiformis</u> (Gertsel, 1961).

All tobacco varieties cultivated in Malaysia are imported from U.S.A., and hitherto forty nine varieties have already been tested for yield in this country. Based on yield, the varieties Harrison Special and Mc Nair 12 were recommended to growers (Anonymous, 1980b). In 1965, the variety North Carolina 95 was recommended for sandy regions, and the variety Mc Nair 12 for alluvial soils. In 1977, the variety Mc Nair 14 was introduced because it was better than Harrison Special, Mc Nair 12 and North Carolina 95 in terms of disease resistance, leaf colour and texture. However, the continuous planting of one variety, Mc Nair 14, was found to intensify the development of diseases such as bacterial wilt caused by <u>Pseudomonas solanacearum</u> (Nik Masdek, 1982). Therefore, disease screening programmes for tobacco varieties were initiated in 1979 and the results so far indicated that variety Coker 254 produced high yields and good quality tobacco (Musa, 1985).

1.3. THE ROOT-KNOT NEMATODE AND TOBACCO GROWING

Tobacco growers in Malaysia encounter many economic, social and technical problems. Root-knot nematode is an important pest of tobacco and several control measures such as nematode resistant variety and the destruction of crop residues have been recommended (Anonymous, 1974). These recommendations are based on experimental results elsewhere, and no systematic study on the root-knot nematode on tobacco has been carried out in this country. Hence, a study on host-parasite relationship of root-knot on tobacco is necessary to plan the control strategies for the crop under Malaysian farming conditions.

The root-knot nematode is one of the important pests in the world and has always been a problem on tobacco. The two most important species attacking tobacco in the tropics are M.incognita and M.javanica. In U.S.A., these two species together with M.hapla and M.arenaria caused an estimated loss between 8-12 % of tobacco crop (Jenkins et al, 1963). In another major producing country, Zimbabwe, M.javanica caused an estimated loss of 18-25 million pounds of cured leaf (Daulton, 1962). Methyl bromide has been recommended for seedbed treatment, while four-year rotation with non-susceptible crop was recommended for the infected fields (Daulton, 1963). Infestation of root-knot nematodes on tobacco has also been reported in other countries such as Madagascar (Breniere, 1959), Peru (Vargas, 1972), Queensland, Australia (Davis, 1964; Colbran and Saunders, 1957), Indonesia (Widjaja Hadisoeganda, 1981) and Sri Lanka (Sivapalan, 1981).