STUDIES ON NEMATODES INFECTING VEGETABLES

BY

TAYSIR BAIRAM ABDEL-RAHMAN

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[signature]

[signature]

[signature]

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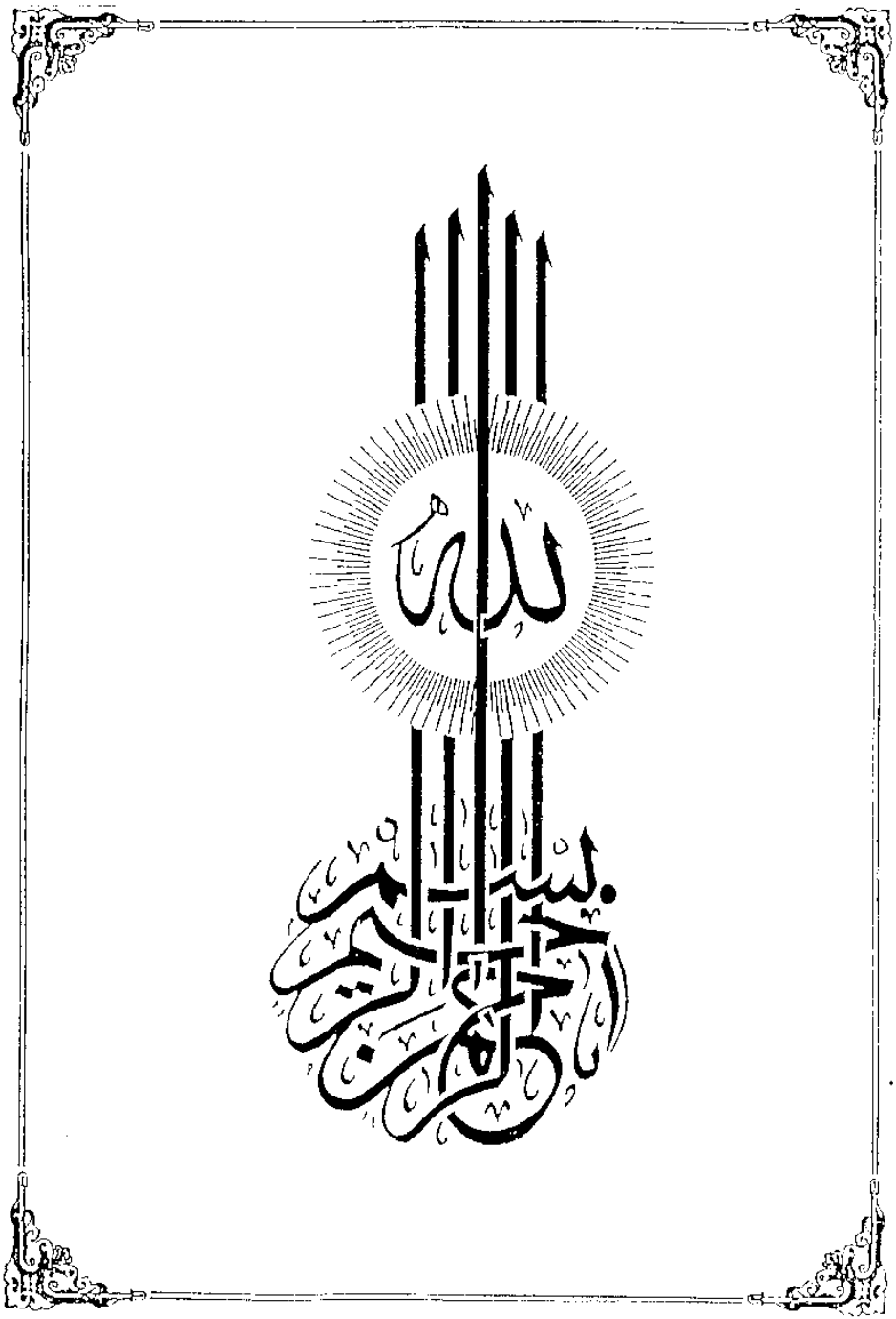

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LIST OF TABLES

I. [illegible]

Although potato, Solanum tuberosum L., is one of the most important vegetable crops in Egypt, very little is known of the nematodes which attack it, and particularly of their effect on growth and yield under the local conditions. In 1971, this vegetable crop was grown to some 65.629 feddans, producing 450.596 tons in both summer and Nili periods. It is the most important cash crop among the vegetable crops of Egypt. Therefore, the reduced yield and blemished reduced market quality of potato tubers resulting primarily from nematode infection are the factors must be considered.

As with this objective, there is a critical need for necessary data obtained through nematode surveys within potato fields, field and greenhouse pathogenesis, with extension to host response after chemical treatment to control parasitic nematodes. The above mentioned aspects represent the dimensions of the present work.

II. [illegible]

Nematode occurrence and parasitism on potatoes have been discussed in literature through only reports made on their proportional damage and implications control measures. The following review concerns mainly those aspects included in this study.

Oteifa (1964) initiated a preliminary work on nematodes associated with potatoes in Egypt, and detected the presence of the lesion-nematodes, Pratylenchus brachyurus, and P. coffeae; the stunt nematodes, Tylenchorhynchus latus, T. martini, and T. nothus; and the stubby-root nematode, Trichodorus spp. within surveyed fields.

The first reported incidence of root-knot nematode on potato was made by Neal in 1889, when he found root-knot nematode (Anguillula sp.), Meloidogyne sp. on potato in Florida. Griffin and Stoker (1968) stated that Meloidogyne hapla caused a reduction in root growth and tuber yield, but the major loss was the resultant production of commercially undesired galled tubers. Cunningham (1936) described the life cycle of (Heterodera marioni), Meloidogyne sp. on potatoes, and indicated that three generations were produced in one season, the first in roots, followed by two or expectionally three in tubers. Griffin & Stoker (1968) found the life cycle of M. hapla was 6 weeks at 30°, whereas it was 7 weeks at 25° on Russet Burbank potatoes. Second stage larvae were not

recovered from soil before 10 weeks after inoculation. Parris (1946) reported that the higher soil moisture, the greater tuber galling by (Heterodera marioni), Meloidogyne sp. He found larvae near cambium below swollen lenticles and concluded that nematodes entered tubers through these avenues. Griffin & Jorgenson (1969) stated that root galling of Russet Burbank potatoes by M. hapla increased as temperature increased from 20 to 30°. They also concluded that infection was not greatly affected by tuber size and larvae were able to penetrate both large and small tubers. Further, there was a greater number of larvae infecting big tubers, probably because of greater surface area exposed to larval invasion.

By means of serial sections in soybean roots, Dropkin and Nelson (1960) reported the histological reactions to invasion with M. incognita. They indicated that, cell multiplication started around larval head on the third day of invasion. Giant cells with granular cytoplasm and enlarged nuclei were subsequently formed, associated with hyperplastic aggregations. Oteifa and Osman (1968), stated that 3–6 hypertrophied cells, so called giant cells, were initiated around a single nematode head in watermelon roots. Hyperplastic tissues also occurred around these giant cells, as well as nematode body. They also observed that giant cells varied in their size, shape, number and orientation of their nuclei.

Oteifa (1957) detected the presence of the semi-endoparasite, the reniform nematode, Rotylenchulus reniformis in cotton fields of Egypt. Birchfield (1962) reported that infected cotton plants had few feeder roots and Lambert Thorne (1963) recorded in Texas, that R. reniformis was the cause of poor growth of cotton. Martin (1960) studied the pathogenicity of R. reniformis on sweet potatoes, using two levels of inocula in pots. He found that root system had markedly decreased in weight as nematode inoculum was increased. The same trend was also noted by Sivakumar and Seshadri (1971) through the inoculation of castor plants with different levels of this parasite. They revealed that the nematode was pathogenic to castor, causing growth reduction, shedding of leaves, early flowering, malformation and discolouration of seeds. Similarly, Raju, and Seshadri (1969) found Bhindi, Brinjal and tomato plants also affected in India. They indicated that the host plant had a marked influence on size, development and reproducing capacity of female nematode.

Referring to Birchfield (1962), it was indicated that R. reniformis fed in phloem tissues of cotton. Phloem cells in close vicinity of the nematode head, had stained darker than other surrounding tissues. Thus, they concluded this necrosis in phloem, contributed to severe root pruning of seedlings and caused the consequent dwarfing to cotton. On

the other hand, Oteifa and Salam (1959) reported that this nematode fed on pericycle zone of young cotton roots or periderm of aged roots. They reported an evidence formation of giant cells in the pericycle zone and stated that, such hypertrophied pericycle cells were incapable to divide for the rise of branch roots. They attributed the poor root growth of infected plants to the inhibitory action of the damaged pericycle cells, rather to the pruning mentioned by Birchfield (1962).

The migratory endoparasitic nematode, Pratylenchus penetrans, has been recognized as the cause of sickness symptoms in potatoes by Oostenbrink (1954, 1955). Oteifa (1962) recovered ten species of the genus Pratylenchus from different crop fields in Egypt. He found that P. penetrans and P. scribneri were the prevalent species associated with potatoes and sweet potatoes. He indicated that the different species of Pratylenchus were important biological factor in the determination of their hosts. Oostenbrink (1958) inoculated potato with P. penetrans in pots and obtained positive correlation between the damage and eelworm density in roots. Plants retarded in growth and exhibited unhealthy appearance in general. Dickerson, Darling and Griffin (1964) found that P. penetrans was wide spread in potato fields of Wisconsin, associated with reduced yields. Plants were checked in vigour,

turned yellow producing both reduced root system and yield. The nematode being a cortical feeder, caused numerous darkened elongate lesions on roots. Tubers, though infected when small, did not show any lesions or pimpling on their surface.

Emphasizing the observations made by Dickerson, Darling and Griffin (1964) in potato roots infected with P. penetrans, it was revealed that tunnels and cavities were reproduced in tissues. Some of the affected cells were void of contents, in others, however, the cytoplasm was granular and brown and accumulated around the cell wall. Nuclei were reduced and granular, and cell walls became brown. The damage only occurred in cortical cells, whereas endodermis was not entirely attacked and neither hypertrophy nor hyperplasia was observed. Kheir (1972) indicated that P. zeae on maize, produced mechanical and chemical injuries within cortical tissues of infected roots. Necrotic areas, and lysis of cells with the destruction of their walls, etiolated internal cavities and tunnels in tissues. The affected cortical parenchyma cells appeared deeply stained in both granular cytoplasm and abnormal nuclei. Cell hypertrophy occurred, however, without any evidence of hyperplasia.

Extensive experiments were mentioned in literature on the usage of systemic nematicides as promising compounds for the control of noxious nematodes. Ouden (1968) used Temik

and Lannate for the control of Heterodera rostochiensis on potatoes. He found treatment with Aldicarb (Temik) on sandy loam soil reduced maximum rate of nematode multiplication by 84% on var. "Mintje". In another experiment with these two materials on var. "Liberties", this rate reached to 50 times in untreated soil, 8 times in Lannate, whereas it was only 1.1 times with Temik. Cetas (1971) evaluated Nasanit, Nemacur, Aldicarb, Carbofuran and Di-Syston against P. penetrans on potatoes. Nemacur and Aldicarb were the most effective materials in reducing nematode population and consequently increased the yield. The pre-emergence side dressing of Aldicarb gave the best control and the highest yields of 70 percent over control. Similar results were also achieved by Hawkins and Miller (1971), who compared Aldicarb and Carbofuran in row treatment to control meadow nematode on potato. The same approach was also confirmed by Oteifa (1970) who found that the Aldicarb (Temik) was also efficient for the control of R. reniformis on cotton in Egypt. In this sequence, the successful effectiveness of Temik was verified by other workers e.g., Addoh & Amanquah (1968) against Meloidogyne sp. on kenaf, Steudel & Thielemann (1967) against H. schachtii on sugar beet, and Birchfield & Martin (1968) against R. reniformis on sweet potatoes. In all cases the Aldicarb (Temik) was very effective in giving high nematode kill as well as increasing the resultant yield considerably.

II. MATERIAL AND METHODS

Collection of soil samples:

Two hundred representative soil samples were collected from different counties in Monoufia and Giza Governorates where potatoes S. tuberosum L., are extensively grown. This inspection was carried out in order to investigate distribution and population density of the different nematode genera abundant in local potato fields. Others, were also taken from the area involved in the nematicides field trial in order to determine the population fluctuations under different nematicidal treatments. Each sample was made up by 3 subsamples to a depth of 25 cm, transferred into labelled polyethylene bags and subsequently processed.

Nematode extraction and enumeration:

All soil samples collected throughout the present study were processed by Oostenbrink's technique (1960). The final nematode catch was decanted to about 40 ml in vials, and replicated aliquots, of one ml each, pippeted into Hawksely counting slide, and nematode genera were identified and estimated microscopically.

Pathogenicity tests:

A successive greenhouse experiments were laid down on