

University of Jordan, Amman, Jordan

POPULATION DYNAMICS AND EFFECT OF *MELOIDOGYNE*
INCOGNITA ON DIFFERENT PLANTINGS OF TOMATO IN THE
CENTRAL JORDAN VALLEY

by

W. I. ABU-GHARBIEH

The Jordan Valley (Ghor) is characterized by warm humid winters and hot dry summers, with average monthly temperatures of 15-20 °C and 25-30 °C, respectively. Tomatoes are grown under irrigation during the September — June period. The root-knot nematode thrives under these conditions and has become a limiting factor in tomato culture.

In a preliminary study conducted in the Central Jordan Valley, root-knot nematode larvae were isolated from the soil around tomato roots in relatively low numbers at planting time in September. During the following winter months, larval numbers fell sharply. However, as average temperatures began to rise, starting March through May, the number of larvae isolated increased steadily. (Abu-Gharbieh and Hammou, 1971). Application of nematicides resulted in better plant growth and a longer fruiting period (Abu-Gharbieh and Hammou, 1972).

The purpose of the study reported here was to investigate relationships between prevailing temperatures, root-knot population densities and the effect of the nematode on different plantings of tomato in the Central Jordan Valley.

MATERIALS AND METHODS

Seeds of tomato cv. Claudia Raf were sown at successive intervals in a soil composed of clay, sand and animal manure in the proportion

2:1:1 previously fumigated with methyl bromide (454 g/0.8 m³). The seedlings were transplanted in a field near Dier Alla in the Central Jordan Valley, naturally infested with root-knot nematode *Meloidogyne incognita* (Kofoid *et* White) Chitw., on six dates (at 15 day intervals) starting September 15th, 1971. The field layout was a randomized block design comprising six treatments replicated four times. Each plot contained 4 rows, 5 m long and 120 cm apart; plants were spaced at 30 cm in the rows. At the beginning of each month, soil samples were taken from about the roots, in all experimental plots, and processed for larval counts as described by Christie and Perry (1951).

On January 1st, 1972, 4-6 plants were randomly dug from each plot and examined for severity of galling and egg production. At the end of the experiment (June 1st, 1972) all plants in the middle two rows of each plot were carefully dug and the severity of galling, weight and condition of the root systems determined.

The soil temperature at 1 foot depth was recorded throughout the experimental period. The average monthly temperature of the soil was 30.3, 26.8, 20.8 and 14 °C when the first, second and third, fourth and fifth, and sixth plantings were made, respectively.

RESULTS AND DISCUSSION

Low numbers of larvae were isolated from the soil during the young seedling stage. These larvae presumably hatched from eggs previously present in the soil. As the temperature decreased in October and November so the numbers of larvae isolated also decreased. However, around the middle of December and early January, larvae numbers increased presumably due to the hatching of eggs produced from the primary infection. Shortly after hatching, larvae numbers declined sharply due to low soil temperature during January and February. With a gradual increase in temperature, from mid March to early April, there was a corresponding increase in the numbers of larvae. Later the number of larvae isolated decreased gradually until termination of the experiment. This decrease was attributed to destruction of the heavily infected and rotted root systems (Fig. 1).

When plant roots were examined on January 1st, 1972, they exhibited extensive, large and continuous galling. Secondary and hairy

roots were rare and similarly galled (Fig. 2). Large numbers of egg sacs were found, which indicated high biological activity of the nematode during the seedling stage. At termination of the experiment on June 1st, 1972, only about 15% of the plants had survived. The roots of these plants were heavily galled, which increased their relative weight (Table I). The roots were small, dark and almost completely rotted, whilst secondary and hairy roots were entirely absent.

As compared with the first planting, nematode larvae isolated from about the roots of plants in the second and third plantings, showed a relatively small rise in numbers in December and January. Numbers dropped sharply during the winter months thereafter, and were maintained at a very low level until about mid April (i.e., about one month later than the first planting). The nematodes then gradually increased in numbers to attain peaks at termination time (Fig. 1).

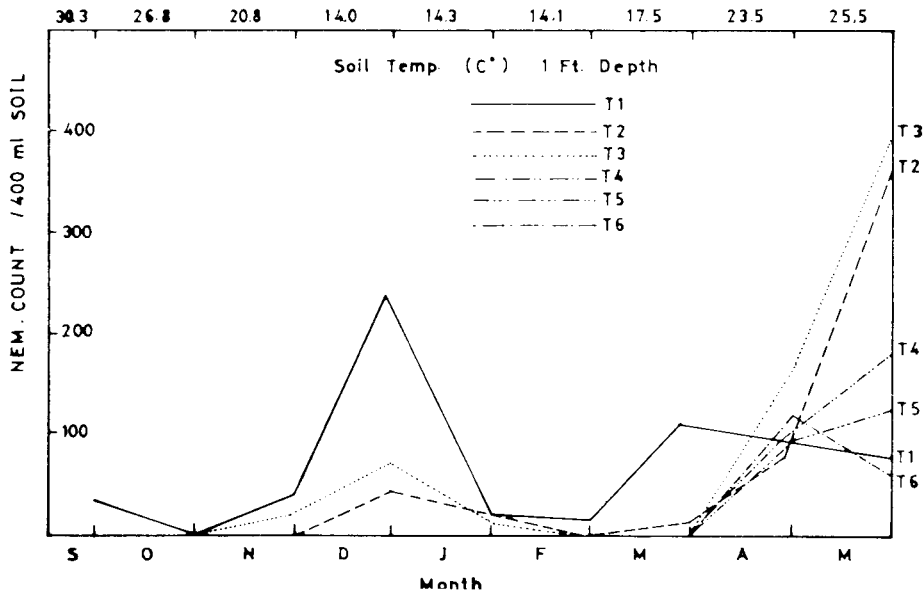


Fig. 1 - Population densities of the root - knot nematode larvae at six planting dates of tomato (T1 - T6).

In the examination made on January 1st only a few small galls and egg sacs were found on the roots (Fig. 2). By June 1st only 30%

of the plants remained alive, and these had small roots with large, continuous and rotted galls (Table I). The few remaining secondary roots were also severely damaged.

No nematode larvae were detected from the soil of the fourth, fifth or sixth plantings until May 1st, 1972. Numbers remained at a relatively low level until termination of experiment (Fig. 1). This was attributed to the fact that very little or no root infection occurred during the early stages of seedling development (Fig. 2). The remaining period was too short to allow a marked increase in nematode popu-

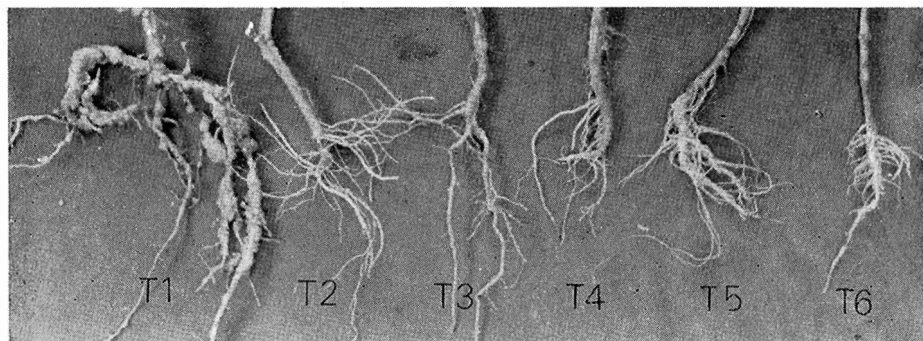


Fig. 2 - Representative tomato roots examined on January 1st, 1971, demonstrating root-knot nematode galling at six planting dates (T1 - T6).

lation densities and therefore smaller numbers were isolated as the date of planting was delayed (Fig. 1).

Roots of the fourth planting were severely infected by termination time, while the roots of both the fifth and sixth plantings showed fewer numbers of galls. This may suggest that the nematode larvae were able to penetrate roots of seedlings in the fourth planting but were unable to develop due to low temperatures.

As planting date was delayed, plant survival was higher (42, 56 and 67%, for the fourth, fifth and sixth plantings respectively) and better roots were maintained (Table I). The average weight of the root systems was comparatively low in the latter planting due to the fact that there were fewer and smaller root galls.

Table I - *Tomato response to Meloidogyne incognita at six dates of planting.*

Planting Date	Root weight (g)	Root size index ^a	Root galling index ^b	Surviving plants %
Sep. 15,71 (T1)	50.0	2.7	4.0	15
Oct. 1,71 (T2)	86.5	2.4	3.7	30
Oct. 15,71 (T3)	108.0	2.3	3.7	30
Nov. 1,71 (T4)	154.0	2.5	3.5	42
Nov. 15,71 (T5)	176.5	3.1	3.2	56
Dec. 1,71 (T6)	109.0	3.2	2.2	67

^a 1-4 scale: 1 = small roots, no hairy roots present and 4 = large roots, extensive hairy roots.

^b 1-4 scale: 1 = no galling and 4 = maximum galling and root rotting.

CONCLUSIONS

The results indicate a high correlation between population densities, biological activities of the root-knot nematode, *M. incognita*, and soil temperature. It appeared that the nematode was active during September and October. This was followed by a general decline of activity in the winter months. With rising temperatures, starting in March, the nematode resumed a steady increase in its biological activity until the end of the experiment on June 1st, 1972.

Seedlings planted in September and October were subjected to infection in the early stages of development. Such infection resulted in the production of stunted and unthrifty-looking plants that frequently died. Seedlings planted in November and December escaped the early infection. In the latter plantings infection began in the spring, and the nematode failed to build-up sufficiently high population densities to affect the well established root systems.

It could be concluded, therefore, that susceptible tomato cultivars may safely escape root-knot nematode infection, in the Central Jordan Valley, by planting during November through December. Earlier plantings must be supplemented by soil fumigation, use of resistant varieties and/or use of cultural practices that reduce nematodes' populations in the soil.

S U M M A R Y

A tomato cultivar, (Claudia Raf) susceptible to *Meloidogyne incognita* (Kofoid et White) Chitw., was planted on six dates at 15 day intervals starting September 15th, 1971. Seedlings planted in September and October were infected in the seedling stage, even though only low populations of the nematode were present in the soil. Seedlings planted in November and December, however, were not infected in the seedling stage and no nematode larvae were recovered from the soil. At the termination of the experiment roots of plants in all plantings were galled but severity of galling and the effect on plant vigour and thriftiness decreased with delay in planting.

R I A S S U N T O

Dinamica delle popolazioni di Meloidogyne incognita ed influenza dell'epoca di trapianto sugli attacchi a Pomodoro nella Valle del Giordano Centrale.

La varietà di Pomodoro Claudia Raf, suscettibile a *Meloidogyne incognita* (Kofoid et White) Chitw., è stata trapiantata, in sei epoche differenti, in un terreno infestato dal nematode nella Valle del Giordano centrale, ad intervalli di 15 giorni, con inizio il 15 settembre 1971. I semenzali trapiantati in settembre ed ottobre sono stati infestati sin dall'inizio, benché nel terreno ci fosse un bassissimo numero di nematodi, mentre quelli trapiantati in novembre e dicembre non hanno subito gli attacchi del nematode nei primi stadi; del resto nel terreno non sono stati osservati stadi mobili del nematode. Al termine della prova tutte le piante presentavano galle sulle radici, ma l'intensità degli attacchi e l'effetto ritardante sulla crescita delle piante era minore sui semenzali trapiantati più tardi.

L I T E R A T U R E C I T E D

- ABU - GHARBIH W. I. and HAMMOU A. H., 1971 - Chemical Control of the Root-Knot Nematode on the Fall Planting of Tomato. Annual Report, Department of Agricultural Research and Extension Jordan. (Abstr).
- ABU - GHARBIH W. I. and HAMMOU A. H., 1972 - Control of the Root-Knot Nematode *Meloidogyne incognita*, on Tomato Using Different Concentrations of DBCP. *Pl. Prot. Studies, Department of Agricultural Research and Extension, Jordan*, 1: 49-53.
- CHRISTIE J. R. and PERRY V. G., 1951 - Removing Nematodes From Soil. *Proc. helm. Soc. Wash.* 18: 106-108.

Accepted for publication on 16 September 1977.