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Seasonal Population Dynamics, Horizontal and Vertical Distributions of Phytonematodes in Date-palm cv. Samani in Egypt

M. F. M. Eissa [1], M. A. El-Sherif [2], M. M. Abd-El-Gawad [1], A. E. Ismail [1, 3] and Wafaa, M. A. El-Nagdi [1]

[1.] Plant Pathology Department, Nematology Laboratory, National Research Centre, Dokki, P. O. Code 12622, Cairo, Egypt

[2.] Agricultural Zoology and Nematology Department, Faculty of Agriculture, Cairo University, Cairo, Egypt

[3.] Corresponding author, Email: iismail2002@yahoo.co.uk; FAX: +20-2-3337-0931

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ABSTRACT

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Concerning the nematode seasonal fluctuations in date-palm cv. Samani over one year, the data indicated a fairly negative correlation between soil temperature and populations densities of *Criconemoides* spp., *Helicotylenchus* spp. and *Meloidogyne incognita*. As for the horizontal distribution, the results showed that the root-knot nematode, *M. incognita* have attained the highest density at 0.5 m distance from the palm tree. However, the highest density of the spiral nematode, *Helicotylenchus* spp. was found at 2 m distance from the palm tree. The vertical distribution of nematodes associated with date-palm cv. Samani generally showed that all nematode genera were found in higher densities at a depth of 30-60 cm. Nevertheless, at depth of 70-90 cm only three genera viz., *Criconemoides*, *Hoplolaimus* and *Tylenchorhynchus* were detected in lower densities.

Key words: Seasonal populations, horizontal and vertical distributions, plant- parasitic nematodes

Date-palm, *Phoenix dactylifera* L. is a crop of dry subtropical zones, grown world-wide in about 1.4 million acres (approximately 80.7 million trees) and 91.7% of which is located in the Arabian countries. In Egypt, there are 8 million date-palm trees of several cultivars grown in about 107,000 acres. Egyptian date productivity is about 55 kg/tree whereas that of USA and Spain is about 71 kg/tree [(6, 13)]. Date-palm trees are economically and socially important especially in the Arab world where they are considered an essential part of tradition. Griffith and Koshy [(7)] reported that up-to 90% young seedlings of date-palm were killed in soil heavily infested by root-knot nematodes. Moreover, numerous nematode pests have been reported to attack the date-palm roots, some of them are more important and cause considerable damage to the plants especially on young seedlings [(3, 4, 5, 6, 9)].

With regard to the seasonal population dynamics of nematodes associated with date-palm trees, few records have been reported by several workers. Al-Khoury [(1)] studied the population of nematodes associated with Al-Wijame diseased date-palm for nine months in Saudi Arabia. These nematodes were *Criconemella*

sphaerocephala, *Helicotylenchus egyptiensis*, *Hemicriconemoides gaddi*, *Longidorus* sp., *Meloidogyne* sp., *Tylenchus* sp. and *Xiphinema* spp. The nematode populations associated with Wijamed date-palm were always greater than non Wijamed * palm trees except for *H. gaddi*. The studied nematodes responded to both soil and air temperature differently and did not follow similar pattern. Nematodes were divided into three groups regarding their response to temperature. Youssef and Eissa[13] studied the seasonal population dynamics of certain plant-parasitic nematodes in soil planted with date-palm cv. Zaghlool over one year in Egypt. They demonstrated that *Helicotylenchus* spp. were most dominant species and their population densities reached to the peaks in July and September which positively correlated ($P < 0.01$) with the soil temperature. Population of *Meloidogyne incognita* fluctuated ($P < 0.01$) with the soil temperature without any sharp increase all over the year around.

Information is scanty about vertical and horizontal distributions of phytonematodes in date-palm orchards. Youssef and Eissa[13] studied the vertical and horizontal distribution of phytonematodes in soil planted with date-palm cv. Siwi. In vertical and horizontal soil samples, higher nematode populations were found at depths of soil layers of 30-50 and 51-70 cm at 1 and 2 m distances from the tree trunk; respectively.

Seasonal fluctuations of plant parasitic- nematodes associated with date-palm was conducted in a sandy loam soil orchard (coarse sand 82%, fine sand 6.1%, silt 8.9%, clay 3%, pH 7.5 and E.C. 1.36), weed-free area at El-Katta village, Giza Governorate that had 30-year-old date-palm trees cv. Samani. The trees were selected at random and labeled as permanent sampling sites. From each palm tree, 3 composite soil samples of 250 g each were collected at monthly intervals for one year by using manual auger. Samples positions were 50 cm around the tree trunks. In all cases, the soil collected was in close contact with the tree roots, while trees harboring weed species beneath them were not sample in order to avoid ambiguous association. Both soil temperature and moisture were recorded monthly at the sampling time. Soil samples were processed for nematode extraction by means of centrifugal-flotation technique[10]. A nematode infested orchard of date-palm cv. Samani (30 years old, 8-10 m length, feeder roots around 1 m depth, fixing and supporting roots may reach to water-table level) located in Berqash village, Embaba County; Giza Governorate was selected to study the horizontal and vertical distributions of nematode. For horizontal distribution, soil samples were collected at a depth of 50 cm and at the distances of 0.5, 1.0, 1.5, 2.0 and 2.5 m from tree trunks. For vertical distribution, soil samples were collected at 5 different depths of 0-30, 31-45, 46-60, 61-75 and 76-90 cm at 50 cm distance from tree trunks. Five samples were collected at each distance or depth. Nematodes were extracted from soil by means of centrifugal flotation technique (10). Root samples were carefully washed with tap water and cut into small pieces for nematode extraction by means of the Baerman pans. Also, % population potential was estimated according to formula:

$$\% \text{ population potential} = \frac{\text{Population density of a given distance}}{\text{Population density at all distances}}$$

Criconemoides spp., *Helicotylenchus* spp. and *Meloidogyne incognita* were found in the rhizosphere of date-palm trees cv. Samani (Table 1). Population of *M. incognita* second stage juveniles (J_2) in the soil showed a high peak in February where soil temperature was 19℃. The lowest population density was found in May where soil temperature was 25℃, but increased in August at 29℃. A negative correlation was evident between soil temperature and the root-knot J_2 population density in this study. Population density of the ring nematode, *Criconemoides* spp. had two peaks, one in February and the other in November. The two peaks were negatively correlated with both soil temperature and moisture, but the population density did not increase significantly at the end of the sampling time. The lowest population density was found in December at soil temperature of 16℃. The spiral nematode, *Helicotylenchus* spp. populations showed similar trend. The lowest population density was found in March and which later increased in April.

Criconemoides spp., *Helicotylenchus* spp., *Hemicriconemoides* spp., *Heterodera* spp., *Hoplolaimus* spp., *Meloidogyne incognita*, *Pratylenchus* spp., *Rotylenchulus* spp., *Tylenchorhynchus* spp. and *Tylenchus* spp. were found in rhizosphere of date- palm trees cv. Samani (Table 2). Horizontal distribution of the nematode genera occurred between 0.5 to 2.5 meters from tree

Table 1. Seasonal fluctuations of three plant-parasitic nematodes associated with date-palm cv. Samani

Months	*Criconemoides*	*Helicotylenchus*	*M. incognita*	Total	Temperature ° C	Soil moisture %
January	34 [1]	13	89	136	16	11.0
February	61	37	202	300	19	4.0
March	15	8	88	111	21	7.0
April	31	41	144	216	21	5.5
May	39	14	40	93	25	4.0
June	33	42	53	128	34	1.2
July	27	41	25	93	28	3.8
August	35	28	68	131	29	2.0
September	9	48	41	98	27	4.5
October	42	29	134	205	22	5.0
November	47	26	147	220	17	4.0
December	6	50	112	168	16	3.0

[1] Values were the average of eight replicates of nematodes per 250 gm soil.

Table 2. Horizontal distribution of nematodes associated with date-palm cv. Samani

Nematode genera	Distance (meter)				
	0.5	1	1.5	2	2.5
Criconemoides	9 [1] (64.3) [2]	5 (35.7)	-	-	-
Helicotylenchus	15 (25.9)	16 (27.5)	4 (6.9)	18 (31.8)	5 (8.2)
Hemicriconemoides	14 (60.9)	3 (13.0)	6 (26.2)	-	-
Heterodera	-	-	15 (30.8)	9 (69.2)	-
Hoplolaimus	14 (11.9)	36 (45.9)	18 (21.1)	8 (7.3)	13 (11.9)
Meloidogyne	22 (73.3)	4 (13.3)	4 (13.3)	-	-
Pratylenchus	12 (2.4)	26 (5.5)	76 (15.8)	123 (25.5)	245 (50.8)
Rotylenchulus	-	11 (10.3)	40 (37.4)	32 (29.9)	14 (13.1)
Tylenchorhynchus	12 (23.5)	-	-	20 (39.2)	19 (37.3)
Tylenchus	19 (13.9)	52 (38.2)	19 (13.9)	9 (6.6)	37 (27.2)
Total No. of nematodes	117	174	182	219	333

[1] Values were the average of eight replicates of nematodes per 250 gm soil.

[2] % population potential = $\frac{\text{Population density of a given distance}}{\text{Population density at all distances}}$

palms. The highest density of the spiral nematode, *Helicotylenchus* spp. and their population potential percentage (18 and 31.8%; respectively) were found at a distance of 2 m from the palm tree. The highest density of the root-knot nematode, *M. incognita* and their population potential % were found at a distance of 0.5 m from the tree (22 and 73.3 %; respectively). The highest density of *Pratylenchus* spp. and their population potential % were also found at a distance of 2.5 m from the tree (245 and 50.8 %; respectively).

Criconemoides spp., *Helicotylenchus* spp., *Hemicriconemoides* spp., *Hoplolaimus* spp., *Meloidogyne incognita*, *Pratylenchus* spp., *Rotylenchulus* spp., *Tylenchorhynchus* spp. and *Tylenchus* spp. found in the

Table 3. Vertical distribution of nematodes associated with date-palm cv. Samani

Nematode genera	Depth (cm)				
	(0-30)	(31-45)	(46-60)	(61-75)	(76-90)
Criconemoides	11[1]	37	-	11	5
	(17.2)[2]	(57.8)		(17.2)	(7.8)
Helicotylenchus	20	16	10	16	-
	(32.3)	(25.8)	(16.1)	(25.8)	
Hemicriconemoides	20	43	-	-	-
	(31.7)	(68.3)			
Hoplolaimus	14	-	4	-	5
	(60.9)		(17.4)		(21.7)
Meloidogyne	8	8	20	-	-
	(22.2)	(22.2)	(55.6)		
Pratylenchus	11	12	-	-	-
	(47.8)	(52.2)			
Rotylenchulus	41	16	29	-	-
	(47.7)	(18.6)	(33.7)		
Tylenchorhynchus	-	4	9	10	-
		(17.4)	(39.1)	(43.5)	
Tylenchus	20	28	9	6	11
	(27.0)	(37.8)	(12.2)	(8.11)	(14.9)
Total No. of nematodes	145	164	81	43	21

[1] Values were the average of eight replicates of nematodes per 250 gm soil.

[2] % population potential = $\frac{\text{Population density of a given distance}}{\text{Population density at all distances}}$

rhizosphere of date-palm cv. Samani trees (Table 3). All genera were found in higher densities at depth of 31-60 cm from the soil surface. The highest density of the root lesion nematode, *Pratylenchus* spp. was at soil depth of 31-45 cm. The highest root-knot nematode population was found at the depth of 46-60 cm. The genera *Criconemoides*, *Hoplolaimus* and *Tylenchus* were the only genera found at a depth of 90 cm from the soil surface.

The study of nematode seasonal fluctuations indicated a negative correlation between either soil temperature or soil moisture and population densities of *Meloidogyne incognita*, *Helicotylenchus* spp. and *Criconemoides* spp. In support of this, the work of Youssef and Eissa [13] found a similar correlation between the lower soil temperature in December and the increased in populations of some plant- parasitic nematodes in date-palm rhizosphere. For example, population of *Helicotylenchus* spp. was higher in December when soil temperature was 16℃. On the other hand, the population of *M. incognita* fluctuated during the year without any obvious peaks. Regular irrigation and the sand soil texture gave nematodes a suitable habitat.

The horizontal and vertical distributions of nematodes associated with date-palm cv. Samani seemed to be correlated with the distribution of date-palm feeder roots. In our study, the feeder roots around 1 m depth , fixing and supporting roots may reach to water-table level as also as plant parasitic nematodes survive on feeder date-palm roots, distribution of these nematodes reflect the presence of feeder roots. The distribution of nematodes appeared to be correlated with the distribution of date-palm feeder roots in all soil depths. Similar results were obtained by Maqbool and Hashmi [11] for *Quinisulcius solani* on potato; Youssef [12] for the rice root nematode, Youssef and Eissa [13] for *Meloidogyne incognita* and *Helicotylenchus* spp. on date-palm cv. Saidi, Eissa *et al.* [2] on banana and Ismail and El-Nagdi [8] on chamomile and Christmas trees.

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摘 要

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2009. 埃及棗椰子 (date-palm cv. Samani) 病原線蟲相週年變動及其垂直與水平分佈. 植病會刊 18: 45-50. ([1] 埃及國家研究中心植物病理系線蟲研究室；[2] 埃及開羅大學農學院農業動物與線蟲學系；[3] 聯絡作者，電子郵件：iismail2002@yahoo.com.uk ；傳眞：+20-2-3337-0931)

調查棗椰子 (date-palm cv. Samani) 病原線蟲種群週年變動情形，結果顯示環紋線蟲 *Criconemoides* spp.、螺旋線蟲 *Helicotylenchus* spp. 及南方根瘤線蟲 *Meloidogyne incognita* 的種群密度和土壤溫度之間呈現負相關。水平分佈方面，南方根瘤線蟲 *M. incognita* 的蟲口密度在距離植株 0.5 公尺處爲最高，至於螺旋線蟲 *Helicotylenchus* spp.則是在距離 2 公尺處。垂直分佈方面，全部所調查的線蟲屬種類在土壤深度 30-60 公分處的密度最高，然而在土深 70-90 公分處仍可發現低密度的環紋線蟲 *Criconemoides*、矛線蟲 *Hoplolaimus* 及矮化線蟲。

關鍵詞：週年種群變動、水平分佈、垂直分佈、植物寄生性線蟲