Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Inventory and Characterization of Phytoparasitic Nematodes Affecting Vineyards in the Tipaza Region (Algeria)

Boughelit Nadia[1,2], Smaha Djamel[3], Hamel Amina[4], Aouswahiba[1], Hamid Sonia[5], Lachibi Moussa[6]
[1]Faculty of Sciences, University of M'Hamed Bougara, BP 35000 Boumerdès, Algeria
[2]Laboratory of Soft Technologies, Valorization, and Physico-Chemistry of Biological Materials, University of Boumerdès, Algeria
[3]Department of Agricultural and Forest Zoology, Higher National School of Agronomy (ENSA), Algiers, Algeria
[4]Faculty of Earth and Life Sciences, Department of Agronomy, Laboratory of Biotechnology and Plant Production, University of Saâd Dahleb, Blida 1, Algeria
[5]Faculty of Natural and Life Sciences and Earth Sciences, University of Bouira, Algeria.
[6]National Institute of Agronomic Research of Algeria, INRAA.
Corresponding author: E-mail: n.boughelit@univ-boumerdes.dz

ARTICLE INFO

Received: 30 May 2025

Revised: 10 Aug 2025

Accepted: 19 Aug 2025

ABSTRACT

In Algeria, viticulture is an important agricultural sector but remains exposed to various pests. Among them, plant-parasitic nematodes represent a serious threat to grapevines. This study was conducted in the wilaya of Tipaza through the sampling of three sites and the analysis of collected specimens in order to identify the species present and assess their impact. The results reveal a high diversity of nematodes, with variable effects depending on the seasons and soil depth. These findings provide a useful scientific basis for better vineyard management and the development of appropriate control strategies.

Keywords: Plant-parasitic nematodes, Vineyards, Mediterranean Sea, Predatory species

Introduction: The vine (*Vitis vinifera*) is considered one of the most important perennial crops in the world, particularly in temperate regions and some tropical areas (Demir, 2014). In Algeria, viticulture holds a significant place in the country's socio-economic fabric. This crop has seen notable development in terms of area and production in recent years, thanks to productive investments by winegrowers and support from public authorities to develop this sector. In fact, in 2022, Algeria recorded a production of 627 000 tons of grapes of all varieties, over an area of 70 000 hectares (Anonyme, 2023). However, in addition to abiotic challenges, several biotic constraints can be listed as limiting factors to vineyard productivity. These include mainly viral and fungal diseases, pests, and weeds (Achbani and Habbadi, 2016).

In this study, our work focused primarily on plant-parasitic nematodes. Several nematode genera can affect vineyards, such as root-knot nematodes (*Meloidogyne* spp.) and those from the genus *Xiphinema*, which are of significant economic importance (Pinkerton *et al.*, 1999; Zasada *et al.*, 2012). These nematodes have been the subject of numerous studies and publications worldwide (Esmenjaud, 2000). Therefore, understanding the dynamics, distribution, and composition of nematode populations is essential to grasp the role of plant-parasitic nematodes in agricultural systems (Dalmasso, 1970). It is well established that the genus *Xiphinema* causes direct primary damage to vines by extracting sap and indirect secondary damage by transmitting viruses of the *Nepovirus* genus. Among them, *Xiphinema index* by far the most widely distributed species globally (Demangeat *et al.*, 2005a,b). In addition to direct damage, it is a vector of the grape vine fanleaf virus (GFLV) (Demangeat *et al.*, 2005a).

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

In Algeria, surveys in vineyards across different regions have shown the presence of several nematode genera, notably *Xiphinema*, *Longidorus*, *Helicotylenchus*, *Pratylenchus*, *Tylenchus*, *Tylenchorhynchus*, *Paratylenchus*, *Pratylenchoides*, *Heterodera*, *Ditylenchus*, *Aphelenchoides*, and *Aphelenchus* (Bounaceur *et al.,* 2011). The species *Xiphinema index* and *Xiphinema pachtaicum* were specifically reported in samples taken from the Had S'hari region in Djelfa (Smaha *et al*., 2023).

The objective of this study is to complete the available data on the distribution of phytoparasitic nematodes of vines in Algeria by conducting a nematological survey in the Tipaza region.

Materials and Methods

Our work was carried out at three stations in the wine-growing region of Tipaza. The selected stations for our study are as follows:
• Eastern Tipaza: Koléa
• Central Tipaza: Cherchell
• Western Tipaza: Hadjret Ennous

For each site, soil sampling was performed using a combination of two different approaches — diagonal and zigzag — in order to improve the representativeness of the samples. The zigzag method is the most commonly used in nematological studies (Hooper, 1993). The first sampling was conducted in December 2023 (winter) and the second in spring (March–April 2024), in order to obtain a seasonal comparison (Hoceini et al., 2020). Samples were taken at two depths: more than 40 cm (40–60 cm) and more than 80 cm, with the aim of analyzing the vertical distribution of nematodes (Barker, 1985).

For each grapevine plant, one kilogram of soil was collected approximately 50 cm from the trunk using a hoe. The samples were then stored in labeled plastic bags, sealed to prevent drying.

The extraction of phytoparasitic nematodes from the grapevine soil was carried out in the laboratory using the Baermann funnel technique. The nematodes were then observed and counted under a stereomicroscope. Identification was done on glass slides under high magnification using a compound microscope (x40). Morphological identification was based on the observation of specific diagnostic features (length and shape of the stylet, shape of the head and tail, body length, position of the esophageal gland relative to the intestine) using the identification key by Yeates et al. (1993).

Soil nematode populations were expressed as the number of nematodes per cubic decimeter (N/dm^3) (Merny and Luc, 1969).

Results

1.1 Inventory of Nematodes

Nematological analysis carried out in the study stations made it possible to identify a total of 19 genera of nematodes, the density of which varies according to the stations. The nematodes are *Aphelenchus spp., Cephalenchus spp., Xiphinema spp., Ditylenchus spp., Dolichodorus spp., Helicotylenchus spp., Hemicriconemoides spp., Hemicycliophora spp., Heterodera spp., Hoplolaimus spp., Longidorus spp., Meloidogyne spp., Paratrichodorus spp., Paratylenchus spp., Rotylenchulus spp., Trichodorus spp., Tylenchulus spp., Tylenchorhynchus spp. And Criconemoidesspp.*

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Fig. 1. Microscopic photos of nematodes recorded in the vineyard stations. A:*Xiphinemasp*. B : *Hemicriconemoidessp*. C :*Cephalenchussp*. D : *Criconemoisp*. (Original 2024)

1.2 Variations in Average Nematode Abundances (N/dm³)

The results on the distribution of average soil nematode abundances reveal that, in terms of mean values across the different orchards, "Cherchell" stands out with a significantly higher abundance compared to the other stations, placing it at the top of the list in terms of nematode density. "Koléa" exhibits intermediate abundance levels, while the "Hadjret Ennous" station shows relatively lower values.

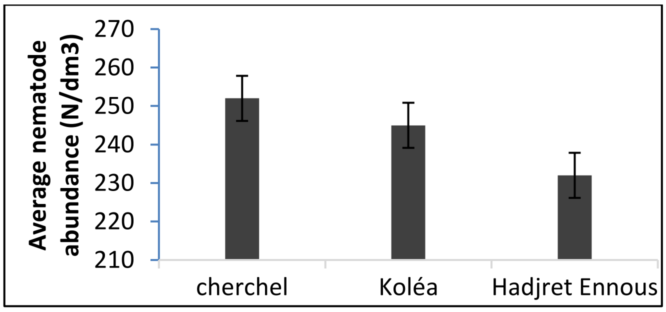

Fig. 2. Variation in Average Nematode Abundances (N/dm³)

1.3 Seasonal Variations in the Average Abundance (N/dm³) of Phytoparasitic Nematode Populations

At the vineyard stations, the average abundances of nematode populations during the winter show relatively high levels, particularly at **Cherchell** and **Hadjret Ennous**, with **151 N/dm³** and **125 N/dm³** respectively. However, these levels decrease in the spring across all stations..

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

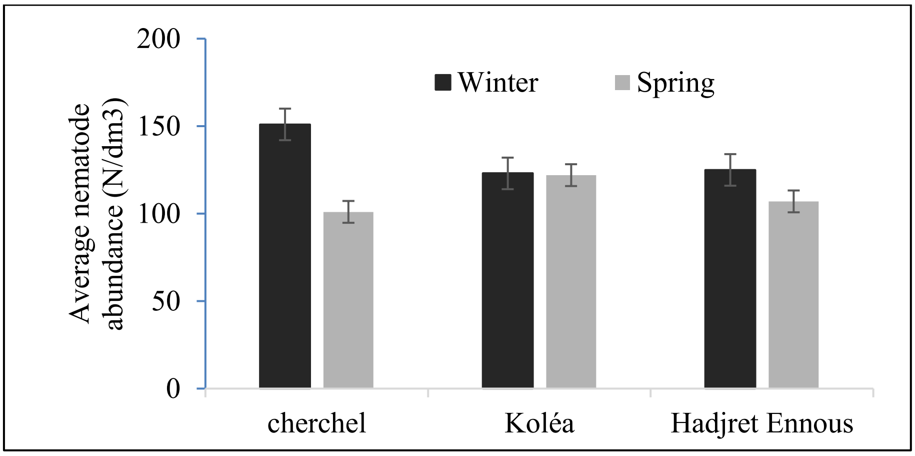

Fig. 3. Seasonal Variations in the Average Abundance (N/dm³) of Phytoparasitic Nematode Populations

In contrast, the Koléa station is the only site where nematode abundance is slightly higher in the spring. This increase, although noticeable, remains relatively modest.

1.4 Variations in the Average Abundance (N/dm³) of Phytoparasitic Nematode Populations According to Soil Depth

Nematode abundance at depths greater than 40 cm was significantly higher in winter across all sites, with **Cherchell** showing slightly higher levels than the others. These values decreased significantly in the spring.
At depths greater than 80 cm, nematode abundance was higher in the spring across all three stations, although **Hadjret Ennous** showed nearly similar values in both seasons.

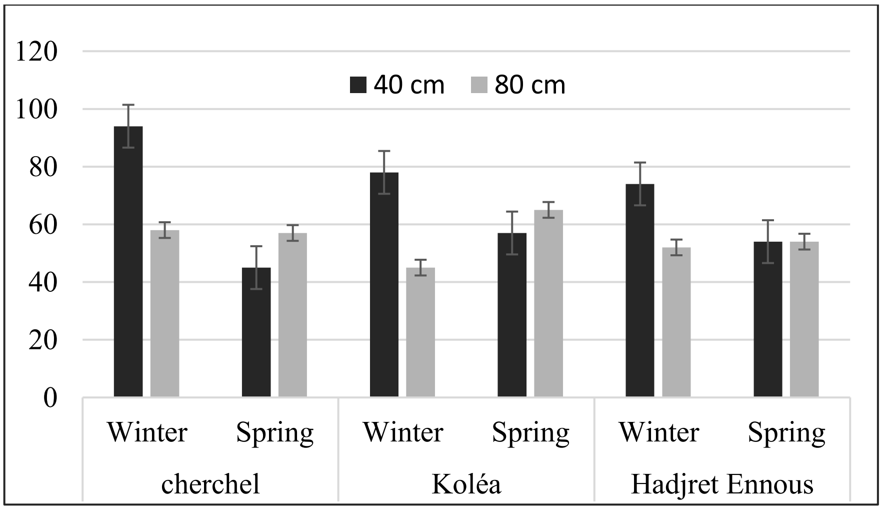

Fig. 4. Seasonal Variations in the Average Abundance (N/dm³) of Phytoparasitic Nematode Populations

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

1.5 Ecological Assessment of Nematode Communities in the Vineyard Stations

2.5.1 Frequency (F%)

The species frequency analysis across the different study stations reveals high frequencies for **Longidorus** (20%), with notable occurrences of other species such as **Helicotylenchus** (11.81%) and **Paratylenchus** (13.49%). Some species, like **Dolichodorus** and **Cephalenchus**, appeared in only a few stations or in very low percentages, which may indicate a more limited or specialized presence.

1.5.2 Absolute Abundance

With an absolute abundance of **354**, **Cherchell** hosts the largest nematode population among the stations. **Koléa** ranks in the mid-range with **345**, while **Hadjret Ennous** shows a relatively low abundance compared to the other stations.

1.5.3. Generic Richness (G)

The generic richness index, which assesses the diversity of taxa in each station, indicates varied values ranging from 10.60 to 18.61 depending on the study site.

Table 1. Spatial Variation of Ecological Indices in the Study Stations

Station	Absolute abundance	Generic Richness (G)
Cherchell	354	17,60
Koléa	343	10,60
Hadjret Ennous	326	17,60

° Absolute abundance: individuals encountered in the study stations

To estimate the total number of nematodes in each study station. This indicates the severity of infestation.

° Generic Richness (G), which measures the diversity of genera among nematodes:
G=S−1logNG = \frac{S - 1}{\log N}G=logNS−1
where:

- **S** = number of genera
- **N** = total number of identified individuals

1.5.4 Total Richness (S)

The study results show that the total nematode richness varies depending on the study stations. The **Cherchell** station has the highest number of taxa, with 18 taxa identified.

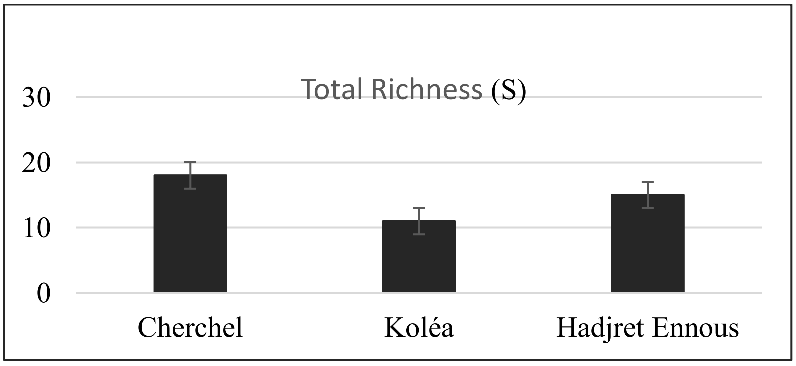

Fig. 5. Spatial Variation of Total Richness in the Study Stations.

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

Discussion

Our results on the inventory of nematodes present in the vineyards of Tipaza are consistent with findings reported in various countries, both in terms of the taxa encountered and the methodological approach. Indeed, the work of Hoceini et al. (2020) in Algeria revealed the presence of Xiphinema spp., primarily in the Médéa plots. Similarly, research by Bounaceur et al. (2011) identified Tylenchus spp. And Aphelenchus spp. in northern Algeria. In Morocco, investigations conducted by Mokrini (2019) highlighted **Paratylenchus spp.** and **Helicotylenchus spp.**, while in Spain, Weiland (2001) identified **Longidorus spp.**.

Ecological indices show variation in nematode diversity between stations. The generic richness index, which quantifies taxon diversity, presents values ranging from 10.60 to 17.60, reflecting differences in taxon richness from one station to another. The average density results also show variations between stations, likely due to differences in soil characteristics or the quantity of weeds present. The presence of weeds seems to be associated with an increased number of roots in the soil, which could explain why nematode density is higher in these areas. This observation is supported by the work of Villenave et al. (2001), who showed that the simple removal of weeds from soil reduces the number of roots available to phytoparasitic nematodes.

The frequency index regarding the distribution of nematode species in the studied stations reveals that Xiphinema spp. and Longidorus spp. are among the most frequently observed in these vineyards. This observation is confirmed by Arias and Navacerrada (1973), who identified the genus Xiphinema in 70% of samples collected from Spanish vineyards, as well as Longidorus, which can also transmit grapevine viruses and is present in Spanish samples.

Our results show that average densities in the stations were nearly similar in spring and winter, with only slight differences. This corresponds with the findings of Hoceini et al. (2020), indicating that soil moisture levels during these periods likely play a role. This idea is also supported by Sarah (1995), who showed that a prolonged dry season reduces populations, which then increase significantly after rainfall.

The results also demonstrate that nematode density varies according to soil depth. We observed a much higher abundance at depths greater than 40 cm than at depths beyond 80 cm. Previous studies (Esmenjaud et al., 1992) already reported a maximal concentration between 40 and 70 cm, linked to better stability in moisture, temperature, and food availability. Other authors (McSorley, 2003; Neher, 2010) confirm that deeper layers maintain ecological micro-stability favorable to nematode survival, unlike superficial layers, which are more exposed to disturbances. Similarly, Howland et al. (2014) demonstrated in *Vitis vinifera* vineyards a clear decrease in the density of studied species with increasing depth, confirming that depths beyond 80 cm are much less favorable than those beyond 40 cm. Finally, the pioneering study by Brodie (1976), which examined the profile down to 105 cm, highlighted that while some species could persist at depth, their maximal density remained between 45 and 75 cm, sharply declining beyond 80 cm.

All these results support the idea that the soil horizon from approximately 40 to 60 cm constitutes an optimal zone for the survival and activity of phytoparasitic nematodes.

Conclusion

Our study, conducted in three vineyard stations in the Tipaza region, confirmed the presence and diversity of phytoparasitic nematodes associated with grapevines. The identification of harmful genera such as **Xiphinema** and **Longidorus** highlights the importance of these organisms as phytosanitary risk factors. These results emphasize the need to integrate nematode monitoring into vineyard management practices and to promote the selection of more tolerant grapevine varieties.

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

Beyond this observation, our findings on the variation in nematode density according to soil depth provide new insights into their ecology. The higher concentration observed around depths greater than 40 cm, compared to deeper layers such as those beyond 80 cm, underscores the critical role of this zone as a preferred habitat due to more stable conditions and better resource availability. This knowledge can help guide cultural practices, particularly in rootstock selection, soil management, and irrigation planning.

Finally, this work lays the foundation for future research aimed at better understanding soil–plant–nematode interactions by incorporating additional parameters such as seasonal dynamics, the impact of cultural practices, and the influence of climate change. Such investigations are essential to develop sustainable strategies for vineyard protection that balance productivity with environmental stewardship.

References

[1] Achbani, E. et Habbadi, K. : La galle du collet de la vigne au Maroc (Région de Fès-Meknès). Agriculture du Maghreb 99: 101-103 (2016).
[2] Anonyme : Note de conjoncture vitivinicole mondiale 2023. Organisation Internationale de la Vigne et du vin (OIV), 21 p. (2023).
[3] Arias, M. and Navacerrada, G.: Geographical distribution of Xiphinema Cobb in Spanish vineyards. Nematologia Mediterranea, Vol. 1, 1, pp: 28-35 (1973).
[4] Bounaceur, F., Safiddine, F., Abedelli, M., Nebih-Hadj Saddok, D. and Bissaad, F.Z.: Contribution to the knowledge of nematodes genera in northern vineyards of Algeria. Annals of Biological Research, 2 (3): 297-306 (2011).
[5] Dalmasso, A. : Annales de zoologie et d'écologie animale. 2, pp : 163-200, (1970).
[6] Demangeat, G., Esmenjaud, D., Voisin, R., Bidault, J.M., Grenan, S. et Claverie, M. : - Le court noué de la vigne. Phytoma, 587: 38-42. (2005a).
[7] Demangeat, G., Voisin, R., Minot, J.C., Bosselut, N., Fuchs, M. and Esmenjaud, D.: Survival of Xiphinema index in vineyard soil and retention of Grapevine fanleaf virus over extended periods of time in the absence of host plants. Phytopathology, 95: 1151-1156, (2005b).
[8] Demir, K.O.K. : A review on grapegrowing in tropical regions. Türk Tarim veDogaBilimleriDergisi 1 : 1236-124, (2014).
[9] Esmenjaud D. : Nématodes de la vigne. Féret., Bordeaux, 2000) pp. 231 (2000).
[10] Esmenjaud, D., Walter, B., Valentin, G., Guo, Z.T., and Cluzeau, D.: Vertical distribution and infectious potential of Xiphinema index (Thorne et Allen, 1950) (Nematoda: Longidoridae) in fields affected by grapevine fanleaf virus in vineyards in the Champagne region of France. Agronomie, (12), 395-399, (1992).
[11] Hoceini, F., Bounaceur, F., Nebih, D., Hamdani, M., et Berrabah, D. : Répartition spatio-temporelle des populations de Xiphenemasp. Dans les vergers de vigne en Algérie. Revue des Régions Arides n°46 (1/2020) – Numéro spécial – Actes du 6e Meeting International, 8p. (2020).
[12] Merny, G. et Luc, M. : Les techniques d'échantillonnage des peuplements de nématodes dans le sol. In :problèmesd'écologie, Paris, France, pp : 237-272 (1969).
[13] Mokrini, F. : Les nématodes phytoparasites associés à la culture de la vigne au Maroc. Revue Marocaine des Sciences Agronomiques et Vétérinaires, 7 (1) (2019).
[14] Pinkerton, J.T., Forge, T.A., Ivors, K.L. and Ingham, R.E.: - Plant parasitic nematodes associated with grapvines, Vitis vinifera, in Oregan vineyards. Supplement to The Journal of Nematology 31(4S): 624-634 (1999).
[15] Sarah, J.L. : Les nematodesphytoparasites, une composante de la fertilité du milieu. Ed. Pichot J., Sibelet N. et Lacoeuilhe J.J. In : Fertilité du milieu et stratégies paysannes : Colloque CIRAD, Montpellier, France, pp : 180-188 (1995).

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

[16] Smaha, D., Mokrini, F., Laasli, S.E., Hamel, A., Khayi, S., Iraqi, D., Lahlali, R. and Dababat, A. A.: First report of the dagger nematodes Xiphinema index and Xiphinema pachtaicum on grapevine in Algeria. Nematropica, Vol. 53: 67-69, (2023).

[17] Villenave, C., Bongers, T., Ekschmitt, K., Djigal, D. and Chotte, J.L.: Influence of tillage and compost on communities of phytoparasitic nematodes. Applied Soil Ecol., 17, 43–52, (2001).

[18] Weiland, C. : Estadosanitariodelcultivo de la vid (Vitis vinifera, L.), respecto a infecciones de carácter viral, en la denominación de origenCondado de Huelva y métodos de saneamientodelmaterialvegetal.219 p., (2001)

[19] Yeates, G.W., Bongers, T., De Goede, R.G.M., Freckman, D.W. and Georgieva, S.S. : Feeding habits in soil nematodes families and genera-an outline for soil ecologists. Journal Nematol., 25, pp: 315 – 331, (1993).

[20] Zasada, I.A., Riga, E., Pinkerton, J.E., Wilson, J.H. and Schreiner, R.P. : Plant-parasitic nematodes associated with grapevines, Vitis vinifera, in Washington and Idaho. American Journal of Enology and Viticulture 63: 522-528, (2012).

[21] Hooper, D. J. (1993). Extraction and processing of plant and soil nematodes. In M. Luc, R. A. Sikora, et J. Bridge (Eds.), Plant parasitic nematodes in subtropical and tropical agriculture (pp. 51–59). Wallingford: CAB International.

[22] Barker, K. R (1985). Sampling nematode communities. In K. R. Barker, C. C. Carter, et J. N. Sasser (Eds.), An advanced treatise on Meloidogyne. Volume II: Methodology (pp. 3–17). Raleigh: North Carolina State University Graphics.

[23] McSorley, R. (2003). Adaptations of nematodes to environmental extremes. Florida Entomologist, 86(2), 138-142.

[24] Neher, D. A. (2010). Ecology of plant and free-living nematodes in natural and agricultural soil. Annual Review of Phytopathology, 48, 371-394.

[25] Howland, A. D., Schreiner, R. P., et Zasada, I. A. (2014). Spatial distribution of plant-parasitic nematodes in semi-arid vineyards. Journal of Nematology, 46(4), 321-330.

[26] Brodie, B. B. (1976). Vertical distribution of plant-parasitic nematodes in relation to soil depth.Journal of Nematology, 8(2), 151-156.