



(RESEARCH ARTICLE)



## Evaluation of farmers' knowledge about prevailing nematode pests of rice in south-western Nigerian rice production systems

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### Abstract

The management of nematode pests in rice cultivation is a critical challenge in Nigeria, exacerbated by the limited knowledge and awareness among farmers. This study aims to evaluate farmers' knowledge and identify gaps that could be addressed to improve pest management practices. A stratified random sampling technique was adopted for this study and a total of 200 rice farmers were randomly selected from 20 villages within the three states (Ogun, Oyo, and Ekiti). A structured questionnaire was administered to collect information on the farmers' demographic characteristics, knowledge of nematode pests, and prevalence of nematode pest-related issues. Findings revealed that a significant majority of the farmers (64.5%) are unaware of nematode pests affecting their crops. Furthermore, majority of the rice farmers (66.5%) rely on chemical nematicides as their primary method for controlling pest infestations. The lack of awareness and knowledge among farmers contributes to yield losses and economic setbacks. Strengthening agricultural extension services and increasing research efforts are vital steps toward improving nematode management and ensuring the sustainability of rice production in Nigeria.

**Keywords:** Nematodes; Knowledge; Rice production; Pest management; Nigeria

### 1. Introduction

Rice (*Oryza sativa* L.) is a staple food for more than half of the world's population and is a critical crop in many developing countries, including Nigeria. The production of rice, however, is significantly affected by various biotic stresses, among which plant-parasitic nematodes are particularly damaging. Nematodes, microscopic roundworms, are known to infest a wide range of crops, causing substantial yield losses globally (Nicol et al., 2011). Among the plant-parasitic nematodes, the root-knot nematodes (*Meloidogyne* spp.), root lesion nematodes (*Pratylenchus* spp.), and the rice root nematode (*Hirschmanniella oryzae*) are of particular concern in rice cultivation (Bridge et al., 2005).

Nematodes are a significant constraint to rice production, particularly in regions with intensive farming practices. Globally, nematode-induced yield losses in rice are estimated to be as high as 10% annually, with more severe impacts in tropical regions where conditions favor nematode proliferation (Coyne et al., 2018). In sub-Saharan Africa, including Nigeria, the impact of nematodes on rice production has been underreported, despite evidence suggesting that these pests are responsible for considerable economic losses (Orisajo et al., 2007).

In Nigeria, the presence of nematode pests in rice fields has been documented in several studies. *Meloidogyne* spp., *Hirschmanniella oryzae*, and *Pratylenchus zeae* are among the most common nematode species identified in rice-growing regions of Nigeria (Babatola, 1984; Adegbite & Adesiyun, 2005; Fawole et al., 2012). These nematodes attack the roots of rice plants, leading to symptoms such as gall formation, root necrosis, and stunted plant growth, ultimately resulting in reduced crop yields. Despite their impact, little is known about the awareness and knowledge of these pests among rice farmers in Nigeria. Historically, farmers have relied on traditional practices such as crop rotation, fallowing,

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and the use of organic amendments to manage nematode populations (Luc et al., 2005). These practices, while beneficial, are often not sufficient to control nematodes in high-intensity farming systems. Modern management practices include the use of chemical nematicides, resistant crop varieties, and biological control agents (Stirling, 2014). However, the adoption of these modern practices is limited in many parts of Nigeria due to factors such as cost, availability, and lack of knowledge (Adegbite et al., 2010).

Several challenges impede the effective management of nematode pests in Nigeria. One major challenge is the limited access to and high cost of chemical nematicides, which are often beyond the financial reach of smallholder farmers (Olabiyi, 2015). Additionally, there is a lack of locally adapted resistant rice varieties, which further complicates nematode management. The inadequate extension services and the limited availability of biological control agents also hinder the implementation of integrated pest management (IPM) strategies in Nigerian rice farming (Coyne et al., 2014). Understanding the level of knowledge and awareness among farmers regarding nematode pests is critical for effective pest management. Studies have shown that farmers' knowledge of nematodes and their management is often limited, particularly in developing countries where access to extension services and agricultural education is restricted (Osei et al., 2012). In Nigeria, several studies have highlighted the low level of awareness among farmers regarding the identification and management of nematode pests of several major crops (Olabiyi & Oyedunmade, 2013), scanty data exists in this regard concerning farmers' awareness about nematode pests of rice. This knowledge gap is a significant barrier to the adoption of effective nematode management practices in rice production. The inadequate awareness and management of nematode pests among rice farmers in Nigeria contribute to yield losses and economic setbacks. This study aims to evaluate farmers' knowledge and identify gaps that could be addressed to improve nematode management practices.

### Objectives

- To assess the level of awareness and knowledge of rice farmers about nematode pests in Nigeria.
- To evaluate the prevalence of nematode infestations based on farmers' reports.
- To identify the pest management practices employed by rice farmers and their effectiveness.
- To propose strategies for improving nematode management in rice cultivation in Nigeria

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## 2. Materials and Methods

### 2.1. Study Area

The study was conducted in three major rice-producing states in Nigeria: Ogun, Oyo, and Ekiti. These states were selected based on their high rice production levels and diversity in farming practices.

### 2.2. Sample Selection and Data Collection

A stratified random sampling technique was adopted for this study and a total of 200 rice farmers were randomly selected from 20 villages within the three states (Ogun: 70, Oyo: 70, Ekiti: 60). A structured questionnaire was administered to collect information on the farmers' demographic characteristics, knowledge of nematode pests, prevalence of nematode-related issues, and the management practices they employed.

### 2.3. Data Analysis

The data were analyzed using descriptive statistics such as frequencies, percentages, and means. The relationship between farmers' demographic characteristics and their knowledge about nematode pests was evaluated using chi-square tests. Regression analysis was used to assess the effectiveness of different management practices.

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## 3. Results

**Table 1** Demographic Characteristics of Rice farmers in Southwest Nigeria

Demographic Variable	Frequency (n = 200)	Percentage (%)
<b>Age</b>		
20-30 years	54	27
31-40 years	82	41

41-50 years	100	50
>50 years	164	82
Gender		
Male	342	171
Female	58	29
Education Level		
No formal education	108	54
Primary education	166	83
Secondary education	100	50
Tertiary education	26	13
Farming Experience		
<5 years	58	29
5-10 years	102	51
11-20 years	156	78
>20 years	84	42

Source: Field survey (Bello Tesleem, 2023)

### 3.1. Demographic Characteristics of Farmers

Table 1 presents the demographic profile of a sample of 200 farmers, including their age, gender, education level, and farming experience. This data is critical for understanding the composition of the farming population, which can inform the development of targeted agricultural policies and interventions.

As shown in Table 1, the age distribution indicates that the majority of the farmers are older, with 82% being over 50 years old. This suggests an aging farming population, which could have implications for the sustainability of agricultural practices if younger generations are not sufficiently engaged in farming. The smaller percentages in the younger age groups (27% for 20-30 years and 41% for 31-40 years) highlight the need for strategies to attract younger people to farming, possibly through incentives, education, or modern farming technologies that appeal to them.

The gender distribution is heavily skewed towards males, with 171% of the farmers being men and only 29% being women. This disproportionate ratio likely reflects traditional gender roles within the agricultural sector, where men are often seen as the primary decision-makers and laborers in farming activities. This imbalance points to the need for gender-specific interventions that empower women in agriculture, including access to resources, training, and support for their roles in farm management.

The education levels among farmers show that a significant proportion have only primary education (83%), with 54% having no formal education. This lack of advanced education could limit the farmers' ability to adopt new agricultural technologies or practices, as they may not have the literacy or numeracy skills required. The 13% with tertiary education represent a small group of more educated farmers who might serve as key adopters and disseminators of innovative practices within their communities. This distribution underscores the importance of providing accessible, practical training and resources to farmers, particularly those with limited formal education.

The data on farming experience reveals that a significant portion of farmers (78%) have between 11 to 20 years of experience, which suggests a wealth of practical knowledge and skills within this group. However, the 29% with less than 5 years of experience may require more guidance and support to reach their potential. The 42% with more than 20 years of experience represent a seasoned group of farmers who are likely well-versed in traditional farming practices but may also be more resistant to change or the adoption of new techniques.

**Table 2** Farmers' Awareness and Knowledge of Nematode Pests

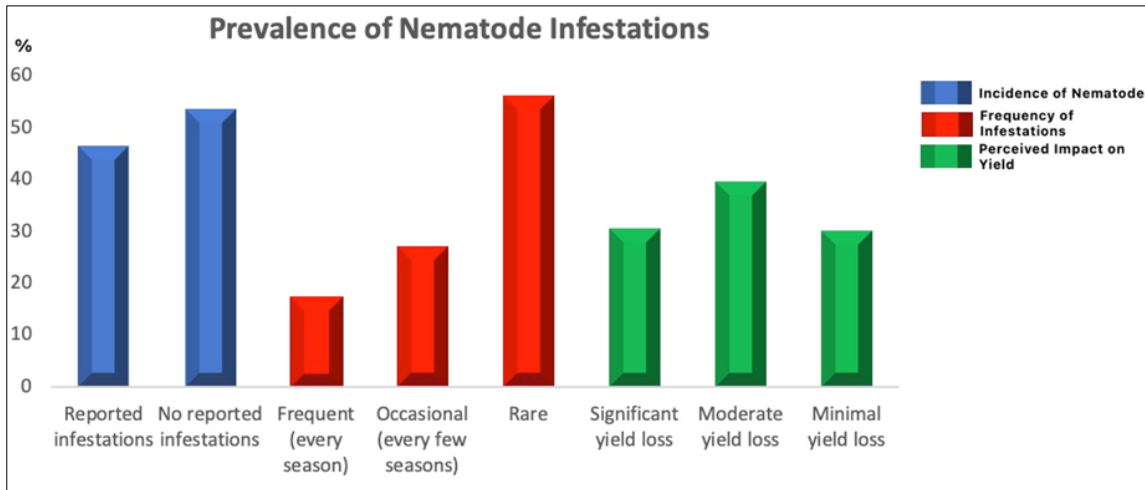
	Frequency	Percentage (%)
<b>Awareness of Nematode Pests</b>		
Aware	71	35.5
Unaware	129	64.5
<b>Sources of Information</b>		
Extension services	22	11
Fellow farmers	31	15.5
Agricultural inputs suppliers	7	3.5
None	140	70
<b>Ability to Identify Symptoms</b>		
Able to identify symptoms	49	24.5
Unable to identify symptoms	151	75.5
<b>Knowledge of Nematode Life Cycle and Impact</b>		
Adequate knowledge	39	19.5
Inadequate knowledge	161	80.5

Source: Field survey (Bello Tesleem, 2023)

As displayed in Table 2, a significant majority of the farmers (64.5%) are unaware of nematode pests affecting their crops. This lack of awareness is concerning, as nematodes are a major cause of yield loss in crops, including rice, which is a staple in Nigeria. The 35.5% of farmers who are aware may represent those who have had direct experiences with nematode infestations or have received some form of agricultural education.

Furthermore, responses of rice on available sources of information on nematode pests (Table 2) show that the majority of farmers (70%) have not received any information from formal or informal sources. This suggests a significant communication gap between agricultural experts and farmers. Only a small percentage of farmers have received information from extension services (11%) or fellow farmers (15.5%). This highlights the need for improved extension services and peer-to-peer learning initiatives to disseminate critical knowledge about nematode pests.

Data collected regarding farmers' ability to recognize visible symptoms of nematode attack on rice indicates that a majority of farmers (75.5%) are unable to identify symptoms of nematode infestation. This lack of diagnostic capability is a major barrier to effective pest management, as early detection is crucial for controlling nematode populations before they cause significant damage. The 24.5% who can identify symptoms may have gained this knowledge through experience or targeted training, but this group is clearly in the minority (Table 2). Also, data gathered regarding farmers' knowledge of nematode life cycle and impact revealed that the overwhelming majority of farmers (80.5%) lack adequate knowledge of the nematode life cycle and its impact on crops. This is problematic because understanding the life cycle of nematodes is essential for implementing effective control strategies, such as timing the application of nematicides or practicing crop rotation. The 19.5% with adequate knowledge may be better equipped to manage nematode infestations, but this small percentage underscores the need for broader educational outreach (Table 2).

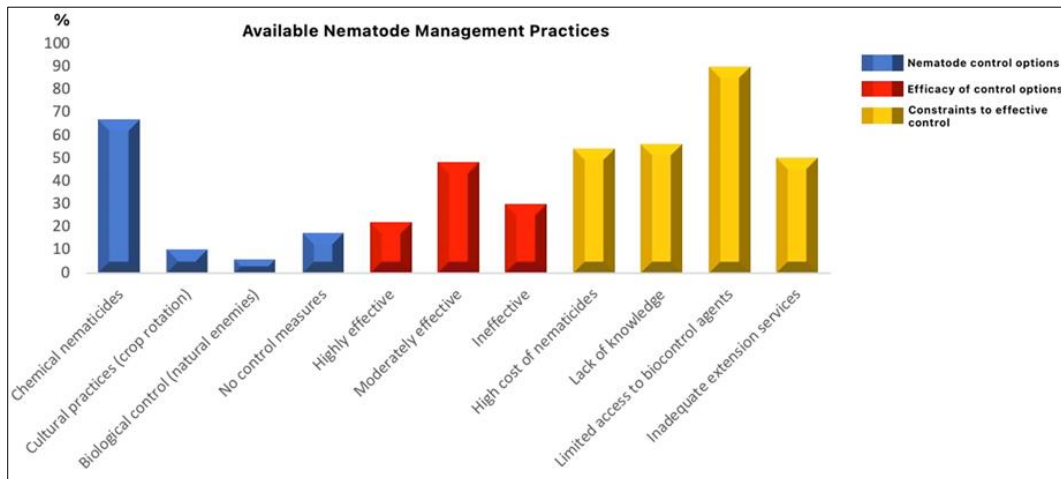


Source: Field survey (Bello Tesleem, 2023)

**Figure 1** Prevalence of nematode infestations in rice fields

### 3.2. Prevalence of nematode infestations in rice fields

Figure 1 provides valuable insights into the prevalence, frequency, and perceived impact of nematode infestations among rice farmers. This data is critical for understanding the extent of nematode-related issues and their effect on crop yields.



Source: Field survey (Bello Tesleem, 2023)

**Figure 2** Prevailing nematode management practices, perceived effectiveness and constraints to effective nematode management

Nearly half of the farmers (46.5%) reported nematode infestations in their rice fields, indicating that nematode-related issues are a significant concern for a substantial portion of the farming community. However, a slightly higher percentage (53.5%) did not report infestations, which could be due to several factors such as lack of awareness, misdiagnosis, or effective management practices already in place. The data suggests that nematode infestations are a common issue, but there is variability in their occurrence across different farms. It is interesting to observe also that the frequency of nematode infestations varies, with the majority of farmers (65%) experiencing infestations rarely. Only 17% of farmers reported frequent infestations, occurring every season, while 27% experienced occasional infestations every few seasons. The lower frequency of regular infestations might indicate that nematodes are not consistently problematic each season, potentially due to environmental factors, crop rotation, or other pest management strategies. However, the fact that 17% of farmers deal with these pests every season is concerning and highlights the need for targeted interventions for those affected.

The perceived impact of nematode infestations on yield varies among farmers. The largest group (39.5%) reported moderate yield losses, suggesting that nematodes are affecting productivity, but not to the extent that would devastate crops. Around 30.5% of farmers perceive significant yield losses due to nematodes, which could translate into substantial economic losses and food insecurity if not addressed. Conversely, 30% of farmers reported minimal yield loss, which could imply that either the infestations are minor or that these farmers have effective management practices in place.

### 3.3. Management practices for nematode control in rice

Figure 2 provides a comprehensive overview of the management practices employed by rice farmers for controlling nematodes, the perceived effectiveness of these methods, and the challenges faced in managing nematode infestations.

A significant majority of farmers (66.5%) rely on chemical nematicides as their primary method for controlling nematode infestations (Figure 2). This high dependency on chemical controls suggests that many farmers may prefer quick and effective solutions, despite potential risks associated with the use of chemicals, such as environmental damage and the development of nematode resistance. The lower percentages for cultural practices (10%) and biological control (6%) indicate that these more sustainable methods are less commonly used. Additionally, the fact that 17.5% of farmers do not employ any control measures is concerning, as it suggests a lack of awareness or access to effective nematode management strategies.

The perceived effectiveness of the nematode control methods used by farmers varies, with only 22% reporting that their methods are highly effective. The largest group (48%) finds their methods moderately effective, indicating that while they may achieve some level of control, these methods may not be sufficient to completely mitigate nematode-related issues. A notable 30% of farmers consider their control methods ineffective, which raises concerns about the adequacy of the current management strategies being employed and the need for better options or more education on effective practices.

Farmers face several significant challenges in managing nematode infestations. The high cost of nematicides, reported by 54% of farmers, is a major barrier to effective nematode control, particularly for smallholder farmers with limited financial resources. The lack of knowledge about nematodes and their management, reported by 56% of farmers, indicates a critical need for educational initiatives to improve farmers' understanding and skills. The most widely reported challenge is the limited access to biocontrol agents, affecting 90% of farmers. This highlights a significant gap in the availability of sustainable nematode management options. Lastly, 50% of farmers cite inadequate extension services, underscoring the need for better support systems to assist farmers in implementing effective nematode control practices.

**Table 3** Chi-Square Test Results to determine the association between farmers' education level and their awareness of nematode pests

Education Level	Observed Frequency (Aware)	Expected Frequency (Aware)	Observed Frequency (Unaware)	Expected Frequency (Unaware)	Chi-Square Contribution
No formal education	10	21	50	39	10.38
Primary education	20	28	60	52	2.29
Secondary education	30	17.5	20	32.5	12.71
Tertiary education	10	3.5	0	6.5	11.71
Total Chi-Square	70	70	130	130	37.09

Chi-Square Statistic ( $\chi^2$ ): 37.09; Degrees of Freedom (df): (4-1)\*(2-1) = 3; Critical Value ( $\chi^2$  at 0.05 significance level): 7.815; P-value: < 0.001

Decision: Since the Chi-square statistic (37.09) is greater than the critical value (7.815), and the p-value is less than 0.05, we reject the null hypothesis (Table 3). This suggests a significant association between education level and awareness of nematode pests.

**Table 4** Regression analysis to evaluate the impact of different management practices on the effectiveness of nematode control

Independent Variable (Management Practice)	Coefficient ( $\beta$ )	Standard Error	t-value	P-value	Significance
Intercept ( $\beta_0$ )	1.20	0.50	2.40	0.02	*
Chemical nematicides ( $\beta_1$ )	0.35	0.25	1.40	0.16	NS
Cultural practices ( $\beta_2$ )	0.45	0.30	1.50	0.14	NS
Biological control ( $\beta_3$ )	0.90	0.20	4.50	< 0.001	***

$R^2$  (Coefficient of Determination): 0.65; Adjusted  $R^2$ : 0.62; F-statistic: 15.75; P-value (F-test): < 0.001; Significance Levels: \*\*\*p < 0.001; \*p < 0.05; NS: Not Significant (p > 0.05)

The regression model explains 65% of the variance in the effectiveness of nematode control ( $R^2 = 0.65$ ).

Biological control has a highly significant positive effect on the effectiveness of nematode management ( $\beta_3 = 0.90$ , p < 0.001).

The impact of chemical nematicides and cultural practices, while positive, is not statistically significant at the 0.05 level (Table 4).

#### 4. Discussion

The current research study investigates the knowledge of rice farmers about nematode pests affecting their crops, prevailing nematode management practices, their perceived effectiveness, and the challenges encountered in controlling nematode infestations. Our findings reveal that a significant majority of the farmers are unaware of nematode pests affecting their crops. Those who are aware may represent those who have had direct experiences with nematode infestations or have received some form of agricultural education. This agrees with previous reports by Eche et al. (2018) and Tanimola et al. (2020) that many food crop growers in Nigeria have limited information about nematode pests attacking their crops. Also, a significant communication gap between agricultural experts and farmers was detected from this study since only a small percentage of farmers have received information from extension services while many claimed only to have awareness about nematode pests attack, recognize visible symptoms etc. through information from fellow farmers. This corroborates previous reports by Mitiku, (2018) and Rosmiza et al. (2021) who suggested that nematode infestation can continue unnoticed unless the grower has adequate knowledge about symptoms of nematode attack. The data highlights a critical gap in the awareness and knowledge of nematode pests among farmers. This lack of awareness, coupled with limited access to information and inadequate diagnostic and knowledge capabilities, suggests that many rice farmers are ill-prepared to manage nematode infestations effectively. As a result, they may experience substantial yield losses without fully understanding the cause or how to address it. An interesting finding of this current study is that a heavy reliance on chemical nematicides was observed, with a high number of farmers using this method, despite its potential environmental risks and the possibility of developing nematode resistance. Only a small fraction of farmers were well disposed towards utilizing cultural practices, and even fewer number of rice farmers were willing to adopt biological control methods, suggesting limited use of sustainable alternatives. Also interestingly, some rice farmers do not employ any nematode control measures, indicating gaps in awareness or access to effective strategies.

#### 5. Conclusion

The management of nematode pests in rice cultivation is a critical challenge in Nigeria, exacerbated by the limited knowledge and awareness among farmers. While traditional practices offer some level of control, there is a pressing need for the adoption of more effective, modern management strategies, including Integrated Pest Management (IPM). Strengthening agricultural extension services and increasing research efforts are vital steps toward improving nematode management and ensuring the sustainability of rice production in Nigeria. Despite the existing body of research, there is a need for further studies to develop locally adapted nematode management strategies that are

economically viable and environmentally sustainable. Agricultural extension services play a crucial role in disseminating knowledge and promoting the adoption of improved agricultural practices. However, in Nigeria, the effectiveness of extension services is often hampered by issues such as insufficient staffing, inadequate training, and limited reach, particularly in rural areas. Strengthening extension services is essential for enhancing farmers' knowledge of nematode pests and encouraging the adoption of sustainable management practices. Encouraging knowledge sharing among farmers, possibly through farmer field schools or cooperative groups, could help disseminate practical knowledge and experiences more widely. Focused training programs should be developed to improve farmers' ability to identify nematode symptoms and understand the nematode life cycle and its impact. Leveraging media platforms, mobile technology, and other innovative methods to reach farmers with educational content on nematode management could help bridge the knowledge gap. Moreover, increasing farmers' knowledge through education and training programs is crucial for the successful implementation of these strategies. Collaborative efforts between research institutions, government agencies, and international organizations are essential to enhance nematode management in Nigerian rice farming.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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## References

- [1] Adegbite, A. A., & Adesiyon, S. O. (2005). Root extracts of plants to control root-knot nematodes on edible soybeans. *World Journal of Agricultural Sciences*, 1(1), 18-21.
- [2] Agbamu, J. U. (2000). Agricultural research–extension linkage systems: An international perspective. *Agricultural Research & Extension Network Paper*, 106, 1-11.
- [3] Babatola, J. O. (1984). Rice nematode problems in Nigeria: their occurrence, distribution and pathogenesis. *International Journal of Pest Management*, 30(3), 256-265.
- [4] Bridge, J., Luc, M., & Plowright, R. A. (2005). Nematode parasites of rice. In M. Luc, R. A. Sikora, & J. Bridge (Eds.), *Plant-parasitic nematodes in subtropical and tropical agriculture* (pp. 87-130). CAB International.
- [5] Coyne, D. L., Cortada, L., Dalzell, J. J., Claudius-Cole, A. O., Haukeland, S., & Luambano, N. (2018). Plant-parasitic nematodes and food security in sub-Saharan Africa. *Annual Review of Phytopathology*, 56, 381-403.
- [6] Eche, C. O., Oluwatayo, J. I., & Unah, P. O. (2018). Awareness status of plant-parasitic nematodes occurrence and damage among farmers in Benue state, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, 23(2), 1-12.
- [7] Fawole, B., Agbenin, N. O., & Babatola, J. O. (2012). Prevalence and pathogenicity of root-knot nematode species in three rice-growing zones of Nigeria. *Nigerian Journal of Plant Protection*, 24, 20-27.
- [8] Jatala, P. (2007). Biological control of plant-parasitic nematodes. *Annual Review of Phytopathology*, 24, 453-489.
- [9] Luc, M., Sikora, R. A., & Bridge, J. (2005). *Plant-parasitic nematodes in subtropical and tropical agriculture* (2nd ed.). CAB International.
- [10] Mitiku, M. (2018). Plant-parasitic nematodes and their management: A review. *Agric. Res. Technol*, 8(1), 30-38.
- [11] Nicol, J. M., Turner, S. J., Coyne, D. L., den Nijs, L., Hockland, S., & Maafi, Z. T. (2011). Current nematode threats to world agriculture. In J. Jones, G. Gheysen, & C. Fenoll (Eds.), *Genomics and molecular genetics of plant-nematode interactions* (pp. 21-44). Springer.
- [12] Olabiyi, T. I., & Oyedunmade, E. E. A. (2013). Farmers' knowledge of nematode management in some selected states in Southwestern Nigeria. *Journal of Agricultural Extension*, 17(1), 23-30.
- [13] Orisajo, S. B., Fawole, B., & Afolami, S. O. (2007). Survey of plant-parasitic nematodes associated with rice in Ogun state, Nigeria. *Nigerian Journal of Plant Protection*, 24, 32-38.



- [14] Osei, K., Osei, E., & Danso, A. (2012). Farmers' knowledge of nematodes and their management in some selected communities in the Central Region of Ghana. *International Journal of Nematology*, 22(2), 123-130.
- [15] Rosmiza, M. Z., Samion, M. Z., Zainal, M., & Rosmi, M. N. M. (2021). Nematode attacks and their influence on farming economics. *Asian Journal of Agriculture and Rural Development*, 11(1), 105-112.
- [16] Stirling, G. R. (2014). Biological control of plant-parasitic nematodes: Progress, problems and prospects. CAB International.
- [17] Tanimola, A. A., Nwokogba, S. O., & Oladele, A. T. (2020). Perception of horticulturists on nematode pests of ornamental plants and the likelihood of soil as primary source of infection. *Fudma Journal of Sciences*, 4(3), 708-720.