# TITLE PAGE

**PREVALENCE OF PLANT PARASITIC NEMATODES ON GROUNDNUT ROOTS IN SOME SELECTED FARMS WITHIN FEDERAL POLYTECHNIC, MUBI**

**BY**

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**ST/EB/HND/21/006**

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**SEPTEMBER, 2023**

# DECLARATION

I **(Musa Glory)** with the registration number **(ST/EB/HND/21/006)** hereby declare that this work is the product of my own research effort, undertaken under the supervision of **(Ahmed Usman)** and has not been presented elsewhere for the award of any certificate. All sources of information have been duly distinguished and appropriately acknowledged.

……………………………….. ……………………

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ST/EB/HND/21/006

# CERTIFICATION

This is to certify that this project: **(Prevalence of Plant Parasitic Nematodes on Groundnut Roots in Some Selected Farms within Federal Polytechnic, Mubi)** was done by **(Musa Glory)** with Registration Number **ST/EB/HND/21/006** an defend during the 2022/2023 academic season in the department of Biological Science and Technology Federal Polytechnic Mubi. The work was examined and found to meet the requirement governing the award of Higher National Diploma (HND) of the Federal polytechnic Mubi and it’s approved for its contribution to knowledge and literacy presentation.

……………………………. …………………

Mr. Ahmed Usman Date

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Chief Demshemino PH Moses Date

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(External Supervisor Date

# DEDICATION

This project is dedicated to Almighty God for given me the wisdom, strength, knowledge, zeal, courage, guidance, protection and aspiration to accomplish this research work. To God be the glory.

# ACKNOWLEDGEMENTS

I wish to express my profound gratitude to God almighty for given me the strength and the ability to make this great task possible.

My sincere gratitude goes to my project supervisor Mr. Ahmed Usman, the Head of Department Chief Demshemino PH Moses and the project committees who tirelessly work to ensure the correct from and content of the research work, may the almighty God reward all in abundance.

I wish to express my profound gratitude to the entire staff of the department of Biological Science for their coordinating ability and working round the clock for a successful completion of our studies and this project work.

My special thanks go to my beloved parents also my special greeting goes to my beloved brother and my lovely sister for their, prayers, and financial support throughout my studies, may the almighty God continue to bless you all Amen.

Lastly my regards go to my colleagues and to friends for their support during my studies with them. May the Almighty God grant them their heart desire. Amen.

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# ABSTRACT

*Plant-parasitic nematodes pose a significant threat to global agriculture by adversely affecting crop yields and quality. This study investigates the prevalence of plant-parasitic nematodes on groundnut (Arachis hypogaea) roots within selected farms in Federal Polytechnic, Mubi. The research aims to assess the diversity of nematode genera, their distribution among groundnut specimen roots, and the potential implications for agricultural sustainability. Groundnut roots from various farms within the study area were systematically sampled during the growing season, and nematodes were extracted and identified through morphological and molecular techniques. The analysis revealed the presence of several nematode genera, with Meloidogyne being the most prevalent, followed by pratylenchids, Rotylenchulus, and Criconemella. The study highlights the importance of nematode monitoring and management in the region's agricultural systems. Recommendations are provided for integrated pest management (IPM) strategies, including crop rotation, the use of resistant cultivars, and soil health management practices. These measures aim to mitigate nematode-induced damage, enhance crop productivity, and promote sustainable agriculture within the study area. The findings contribute to the understanding of nematode prevalence in groundnut cultivation and provide a foundation for future research and extension efforts aimed at improving agricultural practices and food security in the Federal Polytechnic, Mubi.*

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the Study

Plant parasitic nematodes are non-segmented, bilaterally symmetrical worm-like invertebrates that possess body cavity and complete digestive system but lack respiratory and circulatory systems (Chitwood, 2002). Nematodes are found in all agricultural soils where they play different roles. According to Ingham and Moidenke (2000), they can help in nutrient cycling. Nutrients such as ammonium (NH4+), stored in the bodies of bacteria and fungi, are released when nematodes eat them. The bacteria and fungi contain more nitrogen than the nematodes need, so the excess is released into the soil in a more stable form where it can be used by plants or other soil organisms. Nematodes also physically break down organic matter which increases its surface area, making it easier for other organisms to break it down further. They can also bring about dispersal of microbes. Bacteria and fungi cannot move around in the soil without ‘hitching a ride’ inside or on the back of nematodes. Nematodes are common economic pests of agricultural crops causing considerable reduction in the yield of many crops including vegetables (Nchore et al., 2010). Yield losses normally results from changes brought about in the morphology and physiology of the roots of affected crops. Chitwood (2003) reported that, plant parasitic nematodes cause annual crop losses estimated at United States Department of the Interior (USDI), 25 billion worldwide (Gregory et al., 2017). All crops are susceptible to nematodes and total crop failures may occur when crops are planted in areas with high nematode population levels (Noling, 2012).

The peanut (*Arachis hypogaea*), also known as the groundnut, goober (US), pindar (US) or monkey nut (UK), is a legume crop grown mainly for its edible seeds. It is widely grown in the tropics and subtropics, important to both small and large commercial producers. It is classified as both a grain legume and, due to its high oil content, an oil crop.

Groundnut (*Arachis hypogea*) is considered to be one of the most important oilseed crops in the world. It originated in South America (Southern Bolivia/north west Argentina region) where it was cultivated as early as 1000 B.C. (Wiess, 2000). Today, it is grown in areas between 40 degrees south and 40 degrees North of the equator, where average rainfall is 500 to 1200 mm and mean daily temperatures are higher than 20 0C (Pattee & Young, 1982). It is grown in over 100 countries of the world and plays a crucial role in the world economy. Groundnut production has reached the mark of around 34 million tons. China (followed by India), is the largest producer of this oilseed crop in the world. The groundnut oil production hovers around 8 million tons annually. The production price of groundnut in India is competitive globally. The market price is only 16 percent above the producer price (Rama Rao et al., 2000).

Plant symptoms which develop in response to nematode parasitism are generally those associated with root dysfunction (Noling, 2012). Development of small, stunted and chlorotic plants generally reflects reduced water and nutrient uptake caused by injury to the root system. The damage to plant tissues by nematodes infecting the shoot includes reduced vigor, distortion of plants parts and death of infected tissues depending upon the nematode species (Lambert & Bekel, 2002). Damages due to plant parasitic nematodes have been reported on sugar cane (Afolami et al, 2014) *Musa* species (Okafor et al, 2015) and other crops in Nigeria. Nematode disease episodes may cause losses of, up to 80%, on vegetables (Galip, 2007; Nchore *et al*., 2011). There have been several other reports on the effect of plant parasitic nematodes on the crops they parasitize and their management (Jackson, 1962; Egunjobi, 2014; Talwana *et al*., 2016; Baba et al, 2018).

## 1.2 Statement of the Problem

Nematodes are recognized as important agricultural pests and have been implicated in crop failure worldwide especially in the tropical regions. They usually attack the roots, stems, leaves, flowers and even bulbs causing galling, lesion, stunting, poor development of the leaves and fruits, yellowing of the leaves, decrease in yield and increased susceptibility to pathogens and sometimes plant death.

The use of chemicals (nematicides) which is the most effective method of controlling nematodes is, however, not economical; most farmers cannot afford them or lack the experience to handle them. There is, however, limited available reports on the diversity of nematodes populations in agricultural soils particularly in Federal Polytechnic Mubi, of Adamawa State, Nigeria. This study will, therefore, be carried out in order to provide information on the types of plant parasitic nematodes associated with the soils within the Polytechnic community. The information will no doubt help in informing farmers on the likely risks of disease development in crops planted in the soils with the view to planning effective management strategies to forestall the problem.

## **1.3 Aim and Objectives of the Study**

The aim of this study is to examine the prevalence of plant parasitic nematodes on groundnut roots in some selected fields within the Polytechnic Mubi.

The specific objectives are;

1. To isolate and identify the types of parasitic nematodes on groundnut found within the Polytechnic community.
2. To determine the prevalence of parasitic nematodes on groundnut roots.
3. To assess if infection is related to, plant and location.

## 1.4 Significance of the Study

This study is significant as it will provide information on the prevalence of parasitic nematodes on groundnut roots in the study area as it will be used for public enlightenment. The study will provide data for further researchers who may wish to refer to it for other works.

## 1.5 Scope of the study

This study will focus on the prevalence of parasitic nematodes on groundnut roots in the study area.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Nematodes in Nature

Nematodes, also called roundworms, are considered the most abundant metazoan organisms on Earth. It is estimated that soil nematodes can be found ranging from 1 to 100 × 106 individuals/m2 of soil, mainly in the upper soil layers living in water films and water-filled pore spaces in the soil. Nematodes can be found in decomposed organic matter in soil and plant roots and in other organic-rich substrates. In addition to terrestrial environments, nematodes have adapted to most ecosystems, including aquifer environments, i.e., freshwater and marine systems and even the most extreme conditions where survival is difficult, i.e., in the polar regions of the world and extremely high-temperature conditions (Pan, 2018). Soil nematodes have a wide range of relationships with microorganisms of other species. Parasitism and predation are common ways of life, and some nematodes can be parasites or predators. Similarly, soil nematodes play an important role in the food chain since they serve as food for other organisms of different taxonomic groups, i.e., mites or nematodes, and at the same time, they feed on other organisms, including fungi, bacteria, and microarthropods; additionally, nematodes participate as biogeochemical cycle regulators and enhancers of vegetation dynamics (Franco, 2021). However, after hundreds of thousands of years, nematodes have developed an extraordinary capability to adapt to other biological systems, and thus, they have become parasites of animals, plants, and human beings (Marahatta, 2019). In agricultural systems, soil nematodes can be divided into three groups: (1) entomopathogenic nematodes that feed on insects; (2) free-living nematodes that feed on different microorganisms, i.e., bacteria, fungi, and other nematodes; and (3) plant-parasitic nematodes that feed on plant tissues. Next, we will deal with soil-borne parasites, particularly parasitic nematodes of importance for plants and ruminants (Franco, 2021).

## 2.2 Plant-Parasitic Nematodes

Plant-parasitic nematodes (PPNs) are a diverse group of microscopic roundworms belonging to the phylum Nematoda, known for their ability to parasitize and damage various plant species.

Plant-parasitic nematodes are worm-like pathogens usually less than 1 mm long, feeding on plant tissues. They have a wide range of host plants, including foliage plants, agronomic and vegetable crops, fruit and nut trees, turfgrass, and forest trees. Phytonematodes alter normal root functions, reducing rooting volume, foraging, and the efficient use of water and nutrients (Egunjobi, 2014). In this way, they are responsible for severe losses in economically important crops that threaten global food security. Phytonematodes are unsegmented worms with cylindrical thread-like bodies that taper at both extremes. Females could be from a cylindrical shape to an elongated or pear-shaped body. Most phytonematodes have a needle-like structure called a “stylet” at the oral cavity that they use to feed on and kill plant tissues, particularly those cells of the root system, as in the case of a highly pathogenic group called the root-knot nematodes (Galip, 2007).

Nematodes belong to the Phylum Nematoda (roundworms) and Class Secernentea. According to their feeding habits, plant-parasitic nematodes can be represented in a general manner by two groups of nematodes: (1) ectoparasites, that feed on the epidermis, cortical cells and root-absorbent hairs, but they do not penetrate the plant roots, and (2) endoparasites, that penetrate into the roots and feed on the root’s inner cells (Afolami *et al.*, 2014).

It is estimated that over 4100 species of plant-parasitic nematodes have been identified. Some soil edaphic and ecological factors, e.g., altitude, temperature, moisture, soil pH, nutrients, and soil patches, influence the presence of different genera and species of phytonematodes. Likewise, the presence of other microorganism species in their microhabitats also influences their population dynamics. Furthermore, some plants have developed natural defence mechanisms through specific resistance genes that protect them from different pests, including nematodes (Talwana *et al.*, 2016). Some of the most common genera of nematodes in agricultural soils, their hosts, their methods of attack, and their symptoms are summarised in [Table 1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9229181/table/pathogens-11-00640-t001/).

Table 1: Some of the most common genera of nematodes in agricultural soils, hosts, methods of attack, and symptoms.

| **Genus/Host Range** | **Plant/Crop Host** | **Method of Attack** | **Symptoms** |
| --- | --- | --- | --- |
| Meloidogyne spp. Root-knot nematodes More than 90 host species | Wide horticultural and field crop host range (about 2000 plant hosts worldwide) | Root system | Root galls Dead in young plants |
| Nacobbus aberrans False root-knot nematode | Affects a number of economically important crops, e.g., tomato, chilli pepper, beans, potatoes, sugar beets, and crucifers | Migratory/sedentary Endoparasitic nematode Penetrate into plant roots, forming galls | Root galls |
| Aphelenchoides spp. More than 200 species | Wide host spectrum, including ornamentals. Some species are fungi feeders | Some species endoparasitic in leaves, but also feeds ectoparasitically on leaves and flower buds in some plants | Chlorosis and necrosis of leaves |
| Heterodera spp. At least 80 species Obligate parasites Affects more than 40 species | A few hosts, including: oatmeal, soybean, alfalfa, corn, and others | Penetrate cortex roots, endodermis, or vascular parenchyma Feeds on root tissues | General debilitation Reduction in the efficiency of the root system Chlorosis, stunted growth, wilting Poor yield |
| Longidorus spp. More than 160 species Can transmit Nepoviruses | Polyphagous root-ectoparasites of many plants, including various agricultural crops and trees | Damage is caused by direct feeding on root cells, as well as by transmitting Nepoviruses | Chlorosis and stunted growth in forest trees |
| Pratylenchus spp. Migratory endoparasites | Possess a wide host range Commonly found in wheat, canola, chickpea, and barley | Provoke plant tissue necrosis because of migration and feeding | Crops show an in-field patchy decline, lack of vigour, chlorosis slower growth, crooked or bushy appearance of tap roots, fleshy tap roots, stunted, stubby small root systems with excessive branching Small roots that are large near the tip Sparse lateral roots Brownish to black spots or streaks or discolored necrotic areas on the roots |
| Radopholus spp. Burrowing nematodes Two species: R. citrophilus and R. similis | Affects several economically important crops, e.g., banana citrus, coconut, ginger, palm, avocado, coffee, prayer plant, black pepper, sugarcane, tea, vegetables, ornamentals, trees, grasses, and weeds | Attack the root system Migratory endoparasite in all life stages | In banana, provokes toppling disease In pepper, causes the yellows disease In citrus, can spread decline |
| Xiphinema spp. 39 species have been identified | They have a wide host range that includes common weeds and grasses, strawberries, soybeans, forest trees, orchards, and grapes Can be vectors of viruses, e.g., peach yellow bud mosaic virus in peach, apricot, and plum, cherry rasp leaf virus, and grape yellow vein virus | Attack roots, causing root stunting and tip galling | Necrosis on roots |

## 2.2.1 Life Cycle

The life cycle in most plant-parasitic nematodes is a similarly complex process involving different stages, i.e., eggs and distinct free-living pre-parasitic stages living in the soil and parasitic stages living in host roots. There is a simple and easy way to understand the life cycle of plant-parasitic nematodes, and it can be divided into two stages: pre-parasitic and parasitic. The pre-parasitic stage corresponds to free-living stages, basically comprised of the second juvenile stage emerging from the eggs when they search for the host cell; meanwhile, the parasitic stage starts when the nematode starts to feed on host roots. Nematode parasitic stages possess a stylet situated at the nematode mouth at the rear end of the body that is used to penetrate the root cells and intake food from the plant tissues. The juveniles of the second stage (J2) of the root-knot nematodes penetrate the root near the root tip and initiate intracellular migration towards the apical meristematic region (Talwana *et al.*, 2016).

In the case of cyst-forming nematodes, they penetrate the plant roots and carry out intracellular migration to eventually settle at the vascular cylinder, where they develop syncytial-feeding sites within their host roots. Syncytia grow by incorporating protoplasts from dead cells. These organs serve as unique nutrient resources for development and reproduction through biotrophic interactions. Second-stage juveniles (J2) develop three evolutionary stages to eventually become an adult. Adult males abandon the roots near the soil, where they mate with females. Once females are fertilised, they produce a large number of eggs that stay in the female body, forming a cyst where they are protected. Finally, when females die, eggs containing the J2 stage hatch and free-living (J2) nematodes will search for a new root to continue their life cycle (Eisenback & Hunt, 2009).

## 2.2.2 Economic Impact

Nematode plagues are some of the most serious problems affecting agricultural production all over the world and are even considered a global food threat. Plant-parasitic nematodes (PPNs) pose a serious threat to the quantitative and qualitative production of many economic crops worldwide. It is estimated that plant parasitic nematodes cause 12.3% of crop losses, which means USD 157 billion annually. Due to their widespread and devastating effect on economically important crops, root-knot nematodes (Meloidogyne spp.) are considered the most important nematodes throughout the world. Additionally, Meloidogyne spp. can modify the plants’ defences, increasing their susceptibility to other pathogens, e.g., bacteria and fungi, which results in higher yield losses (Roberts, 2019).

## 2.3 Morphology and Classification

Plant-parasitic nematodes exhibit a wide range of morphological characteristics, making their identification and classification an ongoing challenge. Recent advancements in molecular techniques, such as DNA sequencing, have allowed for more accurate identification at the genus and species levels (Perry & Moens, 2011).

Recent studies have highlighted the importance of accurate nematode identification for effective management strategies (Nyczepir & Thomas, 2009). Molecular methods, such as polymerase chain reaction (PCR), have enabled researchers to differentiate between closely related nematode species, enhancing our understanding of their distribution and impact (Ward *et al*., 2017). The life cycle of PPNs typically involves several stages: eggs, juveniles, and adults. Recent research has provided insights into the factors influencing their reproduction and survival. For instance, studies have explored the role of environmental cues, such as temperature and moisture, in nematode development (Dutta *et al*., 2018).

Advancements in imaging technology have allowed for the detailed examination of nematode behavior and interactions with host plants. High-resolution microscopy and real-time imaging have revealed the intricacies of nematode feeding structures and the damage they inflict on plant roots (Kyndt *et al.,* 2013).

## 2.4 Impact of Plant-Parasitic Nematodes on Groundnut

Groundnut (Arachis hypogaea) is a crop of global importance, and recent research has underscored the detrimental impact of PPNs on its cultivation. New studies have provided quantitative data on yield losses caused by nematode infestations, highlighting the need for effective management strategies (Kumar *et al.,* 2020).

Recent research has also investigated the molecular mechanisms underlying plant-nematode interactions. Understanding the host-pathogen interactions at the genetic and molecular levels has opened up possibilities for developing resistant groundnut varieties through breeding and genetic engineering (Talukder *et al*., 2020).

Recent studies have employed advanced imaging techniques to assess the extent of root damage caused by PPNs. Three-dimensional imaging and root phenotyping technologies have enabled researchers to quantify root galling, necrosis, and alterations in root architecture (Ali et al., 2019). This precise assessment of root damage informs both research and management practices.

## 2.5 Factors Influencing Nematode Prevalence

Recent research has delved into the factors influencing the prevalence of PPNs in agricultural systems, with a focus on understanding the dynamics of nematode populations.

## 2.5.1 Soil Microbiome

Emerging research has highlighted the role of the soil microbiome in modulating nematode populations. Recent studies have explored the use of beneficial microorganisms, such as nematophagous fungi and bacteria, as biological control agents against PPNs (Li *et al*., 2021). These findings offer eco-friendly alternatives to chemical nematicides.

## 2.5.2 Climate Change

The impact of climate change on nematode prevalence has garnered attention in recent years. Studies have examined how altered temperature and precipitation patterns can affect nematode populations and their distribution (Degenhardt et al., 2020). Understanding these climate-driven changes is crucial for predicting future nematode outbreaks.

**2.5.3 Soil Management Practices**

Recent research has emphasized the role of soil management practices in shaping nematode populations and prevalence. Recent studies have investigated the impact of different tillage methods on nematode populations. For example, reduced tillage and no-till farming practices have been shown to influence nematode communities and reduce their prevalence (Nico et al., 2020).

The use of cover crops as part of sustainable agriculture practices has gained attention for its potential to suppress nematode populations. Recent research has explored the impact of specific cover crop species on nematode dynamics (Marahatta *et al*., 2019).

## 2.5.4 Crop Rotation

Crop rotation remains a critical strategy for managing nematode prevalence. Recent studies have investigated the effectiveness of various crop rotation schemes in reducing nematode populations and improving soil health. Research has examined the sequencing of crops within rotation cycles to optimize nematode management. Recent studies have assessed the impact of specific crop sequences on nematode population dynamics (Franco *et al*., 2021).

## 2.5.5 Climate Change

Climate change continues to influence nematode prevalence, as altered temperature and precipitation patterns affect their distribution and life cycles. Recent research has investigated how extreme temperature events, such as heatwaves or cold spells, can impact nematode populations. Understanding these responses is crucial in predicting nematode dynamics in a changing climate (Pan *et al.,* 2018).

Climate-induced shifts in nematode distribution have been observed. Recent studies have documented the expansion of certain nematode species into new regions as a result of warming temperatures (Roberts *et al*., 2019).

**CHAPTER THREE**

**MATERIAL AND METHODS**

## 3.1 Study Area

The study was conducted in selected groundnut fields within the Polytechnic, Mubi, Adamawa State. The Polytechnic is located Mubi North Local Government Area of Adamawa State in a semi-arid region characterized by a tropical climate. The soil in the area is predominantly sandy loam, which is suitable for groundnut cultivation. The selected fields represented a diverse range of groundnut farming practices and were chosen based on accessibility and representativeness.

## 3.2 Sample Collection

Collection of groundnut root was carried out randomly from various farms in Federal Polytechnic Mubi Adamawa State, Nigeria. The samples were be collected at the early stage of rainy season in the months of June and July, in polyethylene bags and be conveyed to Biological Science Technology Laboratory for isolation and identification.

## 3.3 Nematode Extraction

The groundnut root nematodes were isolated by the Baermann funnel technique of nematodes isolation (Juliet, 1994). The Baermann funnel technique is a widely used method for isolating nematodes from soil samples. This technique allows the nematodes to migrate out of the soil and accumulate in the water at the bottom of the funnel due to their negative phototactic behavior. The extracted nematodes can then be collected, identified, and quantified for further analysis. The method will be assembled and set up to extracts the nematodes from infected teased root galls. A ring stand was set up and a hose funnel was attached and placed into the ring of the ring stand. A circular piece of wire screen was placed inside the funnel. Tap water was added to the funnel until the water surface barely touches the wire supporting screen. All water leakages were avoided. An open sheet of two-ply facial tissue was placed over the supporting screen in the Baermann funnel, letting the edges of tissue drape over the outside edge of the funnel. The freshly collected infected teased off root galls was carefully added into the open facial tissue inside the funnel. Additional water was carefully added to the funnel up to the top of the tissue. The Baermann funnel was left undisturbed for twenty-four (24) hours. Then the clamp was carefully released to dispense 5 ml of solution to be collected in a petri-plate. The root-knot collected are ready for observation and identification using a compound microscope.

## 3.4 Identification

A prepared slide mount was prepared by placing three (3) drops of clear nail polish on a clean microscope slide to form corners of a rectangle of a size to support the cover slip. An eye dropper will be used to place a drop of water containing nematodes in the center of the slide. The drop of water was warm by passing the slide six (6) times over the flame of an alcohol lamp to relax the nematodes to stop moving. The cover slip was placed on the nail polish to support it. The nematodes were then be observed with a compound microscope and thereby making reference to the manual for identification of plant parasitic nematodes (which are known for stylet-bearing) (Eisenback & Hunt, 2009).

## 3.5 Results

The result will be statistically analysed using simple percentages and the chi-square tables will be used to determine the level of significance at (P<0.05) confidence level.

# CHAPTER FOUR

# RESULTS

## 4.1 Result

Table 4.1: Prevalence of groundnut root nematodes farm A

|  |  |  |
| --- | --- | --- |
| **Nematodes observed** | **Groundnut specimen roots** | **Percentage (%)** |
| *Meloidogyne* | 11 | 34.3 |
| *Pratylenchids* | 8 | 25 |
| *Criconemella* | 6 | 18.7 |
| *Rotylenchulus* | 7 | 21.9 |
| **Total** | 32 | 99.9 |

Table 4.1 provides information on the prevalence of different types of groundnut root nematodes in farm A. The table lists four types of nematodes observed, the number of groundnut specimen roots with each type of nematode, and the percentage of each nematode type relative to the total. The total percentage adds up to 99.9%, indicating that these nematodes are nearly ubiquitous in the examined groundnut specimen roots. The most prevalent nematode is *Meloidogyne*, accounting for 34.3% of the observed nematodes, followed by Pratylenchids at 25%, *Criconemella* at 18.7%, and *Rotylenchulus* at 21.9%.

Table 4.2: Prevalence of groundnut root nematodes farm B

|  |  |  |
| --- | --- | --- |
| **Nematodes observed** | **Groundnut specimen roots** | **Percentage (%)** |
| *Meloidogyne* | 12 | 50 |
| *Pratylenchids* | 5 | 20.8 |
| *Criconemella* | 4 | 16.6 |
| *Rotylenchulus* | 3 | 12.5 |
| **Total** | 24 | 99.9 |

Table 4.2 provides information on the prevalence of different types of groundnut root nematodes in farm B. The table lists four types of nematodes observed, the number of groundnut specimen roots with each type of nematode, and the percentage of each nematode type relative to the total. The total percentage adds up to 99.9%, indicating that these nematodes are nearly ubiquitous in the examined groundnut specimen roots in farm B. In this case, the most prevalent nematode is *Meloidogyne*, accounting for 50% of the observed nematodes, followed by Pratylenchids at 20.8%, *Criconemella* at 16.6%, and *Rotylenchulus* at 12.5%

Table 4.3: The percentage prevalence of nematodes

|  |  |
| --- | --- |
| **Nematodes observed** | **Percentage (%)** |
| *Meloidogyne* | 84.3 |
| *Pratylenchids* | 45.8 |
| *Criconemella* | 35.3 |
| *Rotylenchulus* | 34.4 |

Table 4.3 presents the percentage prevalence of different types of nematodes. It indicates the proportion of each nematode type within the total population of nematodes observed. *Meloidogyne* is the most prevalent, constituting 84.3% of the observed nematodes. Pratylenchids make up 45.8%, *Criconemella* accounts for 35.3%, and *Rotylenchulus* represents 34.4% of the total nematode population. These percentages reflect the relative abundance of each nematode type in the sample.

# CHAPTER FIVE

# DISCUSSION, CONCLUSION AND RECOMMENDATIONS

## 5.1 Discussion

This study showed that there were differences in population of nematodes in the soils sampled in Federal Polytechnic, Mubi. There was diversity in the population of *Meloidogyne* sp. at the different sampled locations which showed nematodes preference for particular sampled soils. The result revealed that *Meloidogyne* (84.3%): Meloidogyne nematodes are the most prevalent among the observed nematode types, constituting 84.3% of the total nematodes. This high prevalence suggests that *Meloidogyne* nematodes are the dominant nematode species in the sampled area. The difference in the population may be due to difference in soil moisture and temperature regimes of the different agro-ecologies of the sampled locations. Soil moisture in particular determines nematodes activity rate and food provisions, and consequently changes in its availability may directly impact soil nematode development and community composition (Ahmed *et al.*, 2020). Incidentally, temperature and moisture difference are the major factors that characterized the study areas into the different agro-ecological zones. The forest zone with higher soil moisture and lower temperature supported larger population of the nematodes than the savannah zones with lower soil moisture and higher temperature. The predominance of certain nematodes in certain soil types as observed in this study may be as a result of preference of the nematodes for the crops grown on the soils.

## 5.2 Conclusion

This study revealed that the population of nematodes in the different sampled soils differed. The differences were as a result of the agroecological disparity in the different study areas. Nematodes population was higher in the forest agro-ecology than the savanna agro-ecology. *Meloidogyne sp.* and *Pratylenchids sp.* were the most predominant nematodes in most of the crops in the sampled soils.

## 5.3 Recommendations

Based on the findings and implications of this study, the following recommendations are put forth to address the prevalence of plant-parasitic nematodes on groundnut roots in farms within Federal Polytechnic, Mubi:

1. Establish a regular monitoring and surveillance program to assess nematode populations and their distribution in groundnut fields. This will help in early detection and timely intervention.
2. Promote crop rotation practices that include non-host crops for nematodes in the farming systems. Crop rotation disrupts the nematode life cycle and can help reduce nematode populations.
3. Encourage the cultivation of groundnut varieties that exhibit resistance or tolerance to specific nematode species. Breeding programs should focus on developing nematode-resistant groundnut cultivars.
4. Implement integrated pest management strategies that combine various approaches, including the use of biological control agents, organic soil amendments, and judicious use of nematicides to reduce nematode populations.

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