

# FIRST REPORT OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH CHAYOTE (*SECHIUM EDULE* (JACQ.) SW.) IN VIETNAM

Ly Ngoc Tu, Nguyen Tien Thang  
Ha Noi Metropolitan University

**Abstract:** *Chayote, known for its nutrition, is a perennial vine originating from Mesoamerica and now cultivated globally. This study documents the first report of plant-parasitic nematodes associated with chayote (*Sechium edule* (Jacq.) Sw.) in Vietnam, addressing a critical knowledge gap in the pest management of this underutilized crop. Three genera, including *Hirschmanniella*, *Helicotylenchus*, and *Tylenchorhynchus*, were identified, with *Tylenchorhynchus* being the most predominant, averaging 152 nematodes per 250g of soil and found in 100% of soil samples. *Hirschmanniella*, despite a lower density, showed a high frequency of 92.9% in soil samples. Cluster analysis indicated no clear geographic correlation in nematode distribution, suggesting other environmental and agricultural factors play significant roles. The findings highlight the urgent need for targeted pest management strategies, including integrated pest management practices, to mitigate nematode infestations and improve chayote cultivation in Vietnam. This research underscores the importance of investigating underutilized crops to enhance agricultural sustainability and food security.*

**Keywords:** *chayote, Cluster analysis, first report, underutilized crops, Vinh Phuc*

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Liên hệ tác giả: Ly Ngoc Tu ; email: ngoctu1890@gmail.com

## 1. INTRODUCTION

Humanity's reliance on a diverse range of cultivated species, with thousands of species used for various purposes, underscores the significant contribution of both major and minor crops to global food security and agricultural sustainability. While staple crops dominate the majority of food production, the role of minor, underutilized, and neglected crops cannot be underestimated [1]. Despite their importance, these crops have received relatively little attention from the scientific community, particularly in developing countries, leading to a scarcity of research funding and limited information on their biological characteristics and genetic potential [2].

Chayote (*Sechium edule* (Jacq.) Sw.), known by various names such as vegetable pear, christophene, and mirliton, is one such underutilized crop [3]. Originating from Mesoamerica, specifically southern Mexico and Guatemala, chayote has been cultivated since the pre-Columbian era and has spread to other regions including South America, Europe, Africa, Asia, and Australia. This monoecious, perennial, herbaceous vine is valued for its nutritious, pale-green, ridged, fleshy fruit with a single seed. Despite its widespread cultivation and economic importance in many countries, chayote remains relatively under-researched, particularly in terms of its pest management [1,3].

Vietnam, with its diverse agro-ecological zones, presents a unique environment for the cultivation of various crops, including chayote [4]. However, the agricultural sector in Vietnam faces numerous challenges, including the threat posed by plant-parasitic nematodes [5]. Nematodes, such as *Meloidogyne incognita* and *Meloidogyne javanica*, are known to cause significant damage to various crops, including chayote, by affecting their root systems as reported in the world [6, 7]. However, the impact of plant-parasitic nematodes on chayote cultivation in Vietnam has never been documented.

This study aims to address this knowledge gap by reporting for the first time the association of plant-parasitic nematodes with chayote (*Sechium edule* (Jacq.) Sw.) in Vietnam. By documenting the presence of these nematodes, this research seeks to contribute to the understanding of chayote's pest challenges in the region, thus aiding in the development of effective management strategies. This report not only highlights the importance of investigating underutilized crops but also emphasizes the need for comprehensive agricultural research to ensure the sustainable development and improvement of these valuable resources.

## 2. MATERIALS AND METHODS

**Sampling:** Soil and root samples were collected randomly at four different sampling fields in the growing areas of chayote in Vinh Phuc, Vietnam. At each sampling site, approximately 1 kg of soil and 15 g of roots from the rhizosphere of chayote were collected from the upper 30 cm of the soil layer [5]. The soil and roots were placed in a nylon bag and brought to the laboratory for further steps.

**Extraction:** Nematodes from the 250g of soil and 5g of roots were extracted using the method described by Nguyen (2003).

**Identification:** For morphological examination, nematodes were observed using a stereo microscope and confirmed using a light microscope. Nematodes were identified following Nguyen (2003) and Nguyen et al., (2000)[8].

**Calculating Density and Frequency:** After extraction, the nematode suspension was placed in a counting dish under a microscope to count the number of nematodes of each genus.

- **Average Density:** Total number of nematodes belonging to a specific genus in all samples / Total number of positive samples.
- **Frequency:** (Number of samples having a specific genus / Total number of samples)  $\times 100\%$ .

**Cluster analysis:** To investigate the relationships between nematode compositions in four sampling fields, we conducted a Cluster Analysis using Primer version 6.1.12 [9]. Prior to the analysis, we normalized all data to account for differences in measurement units. We then created a resemblance matrix using the Euclidean distance measure.

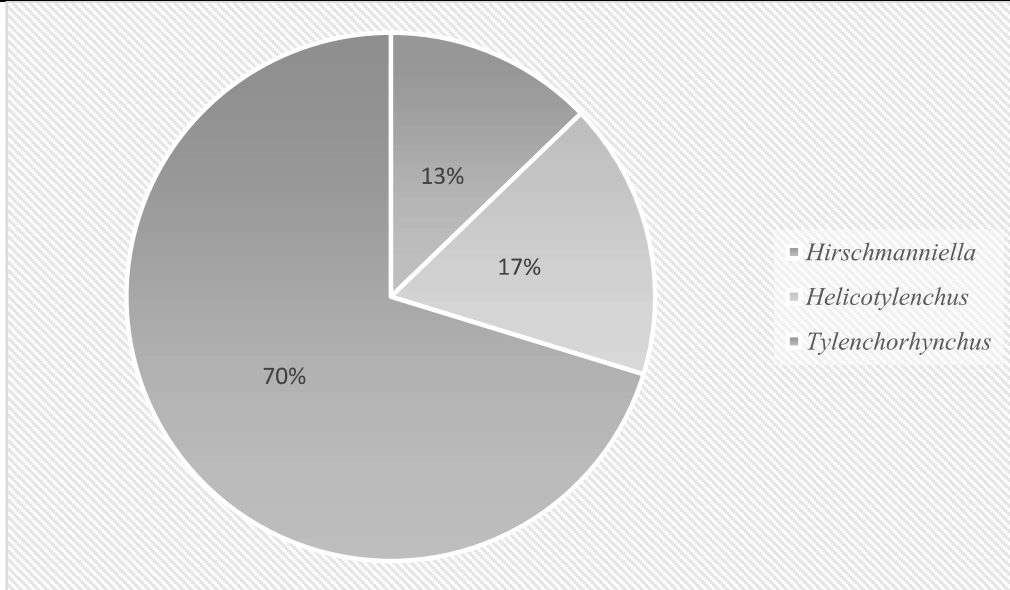
## 3. RESULTS

In the chayote growing areas of Vinh Phuc, three plant-parasitic nematode genera were recorded: *Hirschmanniella*, *Helicotylenchus*, and *Tylenchorhynchus*. Among these, *Tylenchorhynchus* appeared with the highest density, averaging 152 nematodes per 250g of soil (Table 1), and comprised 70% of the total number of individuals (Fig. 1).

Table 1. The composition of nematodes recorded on chayote plants

Nematode		Total	Average density (per positive samples)	Frequency
Soil	<i>Hirschmanniella</i>	262	20	92.9

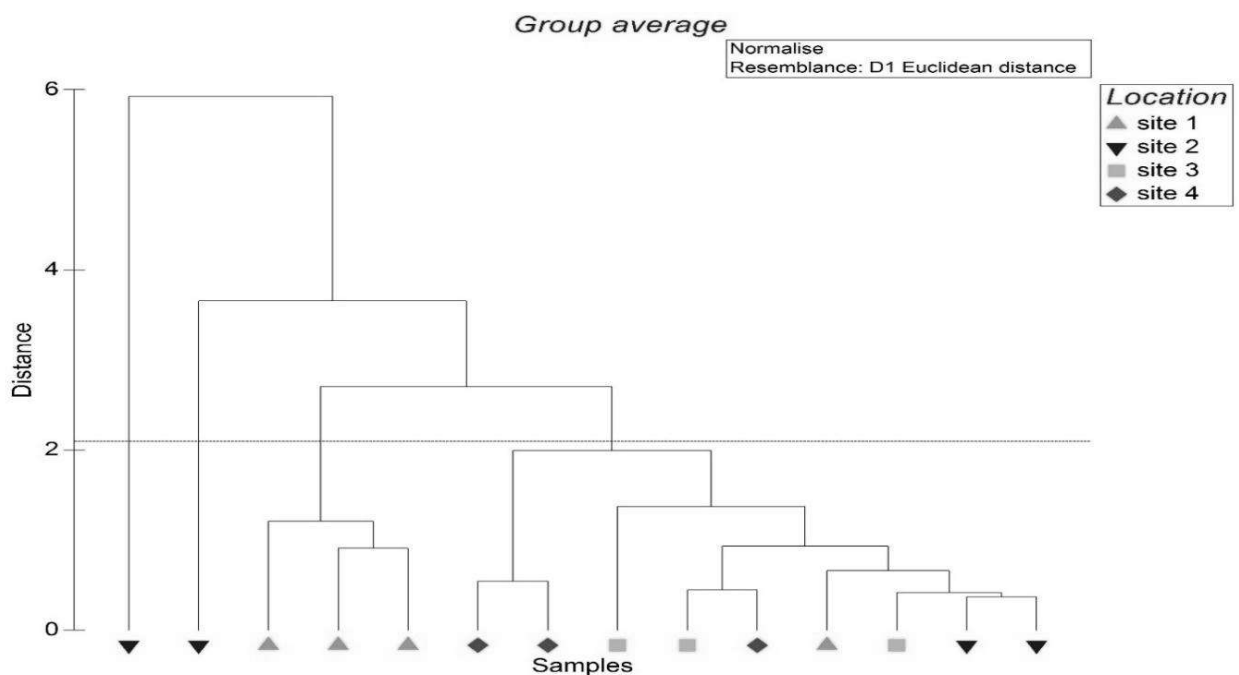
	<i>Helicotylenchus</i>	530	106	35.7
	<i>Tylenchorhynchus</i>	2134	152	100
Root	<i>Hirschmanniella</i>	2	2	7.1
	<i>Tylenchorhynchus</i>	72	8	64.3



**Figure 1.** Percentages of the number of plant-parasitic nematodes in the rhizosphere of chayote in Vinh Phuc

Although *Hirschmanniella* was recorded at a low density (an average of 20 nematodes per positive soil sample), it was present at a very high frequency of 92.9%. *Tylenchorhynchus* had the highest frequency, being found in 100% of the soil samples.

In the root samples, only two genera, *Hirschmanniella* and *Tylenchorhynchus*, were recorded. However, the average densities of these plant-parasitic nematodes were relatively low, with 2 and 8 nematodes per 5g of root, respectively.



**Figure 2.** Cluster analysis of nematode composition from different sampling fields.

Figure 2 reveals no distinct pattern in the grouping of sampling sites, suggesting that the distribution and composition of plant-parasitic nematodes in chayote growing areas do not correlate with the sampling locations. Notably, the nematode compositions of samples collected from site 2 exhibited significant variability, as indicated by the high Euclidean distances. This lack of correlation implies that factors other than geographic location may play a more crucial role in influencing nematode distribution and composition in these areas.

#### 4. DISCUSSION

This study provides the first documentation of plant-parasitic nematodes associated with chayote in Vietnam, highlighting the significant presence of *Tylenchorhynchus* and *Hirschmanniella* in the region. The results emphasize the need for targeted research and management strategies to address nematode-related challenges in chayote cultivation. By enhancing our understanding of these pest dynamics, this research contributes to the broader goal of improving agricultural sustainability and food security through the effective management of underutilized crops.

Three genera of plant-parasitic nematodes, i.e., *Hirschmanniella*, *Helicotylenchus*, and *Tylenchorhynchus*, were identified in the chayote growing areas of Vinh Phuc. Among these, *Tylenchorhynchus* was the most predominant, with an average density of 152 nematodes per 250g of soil and a presence in 100% of soil samples. This high density and frequency indicate that *Tylenchorhynchus* poses a significant threat to chayote cultivation in the region. The high frequency of *Tylenchorhynchus*, despite its lower density in root samples, suggests that its primary impact may be on soil health and root system integrity, leading to overall plant stress and reduced yields.

*Hirschmanniella*, while recorded at a lower average density of 20 nematodes per positive soil sample, was found in 92.9% of soil samples. This high frequency, despite low densities, could indicate a pervasive but less aggressive interaction with the chayote plants. The presence of *Hirschmanniella* in both soil and root samples, although at different densities, suggests it has the potential to affect both the root system and the surrounding soil environment.

*Helicotylenchus*, observed only in soil samples with an average density of 106 nematodes per positive sample and a frequency of 35.7%, may exert localized impacts. The lower frequency compared to *Tylenchorhynchus* and *Hirschmanniella* suggests it may be less adapted to the chayote rhizosphere or less competitive in this environment.

The cluster analysis (Fig. 2) did not reveal a distinct pattern correlating the nematode compositions with specific sampling locations. This lack of geographic correlation implies that other factors, such as soil properties, microclimatic conditions, and agricultural practices, may play more significant roles in determining nematode distribution. The significant variability observed in samples from “site 2” highlights the complexity of nematode ecology and the potential influence of localized environmental conditions or crop management practices.

The presence of plant-parasitic nematodes, particularly *Tylenchorhynchus* and *Hirschmanniella*, at high frequencies suggests a substantial potential for damage to chayote crops. These nematodes can affect root health, leading to reduced water and nutrient uptake, stunted growth, and overall lower yields. Addressing these pest issues is crucial for optimizing chayote production in Vietnam. Given the findings, integrated pest management strategies should be developed and implemented to mitigate nematode infestations in chayote fields. Such strategies could include crop rotation, the use of nematode-resistant chayote varieties, and soil health improvement practices such as organic amendments and biological

control agents. Further research is needed to explore these options and to develop specific recommendations tailored to the local agro-ecological conditions.

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## DẪN LIỆU BƯỚC ĐẦU VỀ LOÀI TUYẾN TRÙNG KÍ SINH THỰC VẬT LIÊN QUAN ĐẾN CÂY SU SU (*SECHIUM EDULE* (JACQ.) SW.) Ở VIỆT NAM

**Tóm tắt:** Su su được biết đến vì giàu dinh dưỡng, là một loại cây dây leo lâu năm có nguồn gốc từ Trung Mỹ và hiện được trồng trên toàn cầu. Nghiên cứu này ghi lại báo cáo đầu tiên về tuyến trùng ký sinh thực vật liên quan đến Su su (*Sechium edule* (Jacq.) Sw.) ở Việt Nam, nghiên cứu này giúp giải quyết vấn đề quan trọng trong việc quản lý dịch hại đối với loại cây trồng thứ yếu này. Ba giống gồm *Hirschmanniella*, *Helicotylenchus* và *Tylenchorhynchus* đã được xác định, trong đó *Tylenchorhynchus* chiếm ưu thế nhất, trung bình có 152 tuyến trùng trong 250g đất và được tìm thấy ở 100% mẫu đất. *Hirschmanniella*, mặc dù mật độ thấp hơn, nhưng có tần suất cao 92,9% trong các mẫu đất. Phân tích cụm cho thấy không có mối tương quan địa lý rõ ràng trong sự phân bố tuyến trùng, cho thấy các yếu tố môi trường và nông nghiệp khác đóng vai trò quan trọng. Các phát hiện này nêu lên nhu cầu cấp thiết về các chiến lược quản lý dịch hại (bao gồm các biện pháp quản lý dịch hại tổng hợp) để giảm thiểu sự xâm nhập của tuyến trùng và cải thiện hoạt động trồng su su ở Việt Nam. Nghiên cứu này nhấn mạnh tầm quan trọng của việc điều tra các loại cây trồng thứ yếu để nâng cao tính bền vững của nông nghiệp và an ninh lương thực.

**Từ khóa:** Su su, phương pháp phân tích cụm, dẫn liệu bước đầu, cây trồng ít được sử dụng, Vĩnh Phúc.