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# Abundance and diversity of terrestrial free-living nematodes in potato agroecosystem

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**Abstract.** *Mutala'liah, Manan A, Bayyinah LN. 2023. Abundance and diversity of terrestrial free-living nematodes in potato agroecosystem. Nusantara Bioscience 15: 129-136.* The presence of terrestrial free-living nematodes in agroecosystems is frequently overlooked. However, these microorganisms in agroecosystems soil are beneficial for supporting plant growth. These microorganisms could recycle the nitrogen in soil, decomposition and mineralization of organic matter, and suppress the densities of plant parasitic nematodes through their life strategy. Terrestrial free-living nematodes are classified according to trophic groups such as bacterivores, fungivores, predators, and omnivores. Reports on the abundance and diversity of terrestrial free-living nematode populations in agroecosystems, especially on potato plantations, were limited. They usually focused on the plant parasitic nematode's attack on potatoes. Therefore, this study aimed to examine the diversity and abundance of terrestrial free-living nematodes in potato agroecosystems. The current study was conducted in two potato fields in Pratin Village, Serang, Purbalingga, Central Java, Indonesia. Soil samples were collected from two potato fields planted with different varieties (Granola and Atlantik) and extracted using the Whitehead-tray method. The variables observed were the diversity of genera and the abundance of terrestrial free-living nematode populations from each field. Population density data were analyzed by T-test, and diversity (H'), evenness (E), and dominance index (D) were also calculated. The results showed that the mean population densities of terrestrial free-living nematodes in the two fields were significantly higher at 918.40 individuals/ 100 g of soil in the Atlantik field than in the Granola field 76.53 individuals/ 100 g of soil. However, the diversity, evenness, and dominance index were not significantly different in both fields. Genera of nematode found in the Granola field were *Diplogaster, Dorylaimus, Tripyla,* and *Lotonchus,* while in the Atlantik field were *Rhabditis* and *Dorylaimus.*

**Keywords:** Beneficial nematodes, biodiversity, genera, potato field

## INTRODUCTION

The agricultural ecosystem consists of some valuable and invaluable organisms regarding plant productivity. Terrestrial free-living nematodes are aquatic organism requiring adequate soil moisture to move in the soil (Yadav et al. 2018). Nematodes are classified as soil microorganisms in the Animalia Kingdom, which have several roles in the agricultural ecosystem, i.e., free living in the soil, plant-parasitic, and entomopathogenic nematode (Iqbal and Jones 2017). Free-living nematodes are the most abundant in the agricultural ecosystem, feeding on some organisms like algae, bacteria, and fungi (Iqbal and Jones 2017). Free-living nematodes play an important role in decomposition and nutrient recycling. In addition, these organisms are very important in protecting the soil's organic nature, assisting colonization of microbial substrates and nutrients mineralization in the soil, and feeding on other soil microbes like plant pathogens and soil insect pests (Iqbal and Jones 2017; Hailu and Hailu 2020). Terrestrial free-living nematodes are also considered to be used as soil health and quality indicators (Linsell et al. 2014). Soil nematodes are classified into five trophic groups and life strategies i.e., bacterial feeders, fungal feeders, plant feeders, omnivores, and predators (Kekelis et al. 2022).

Terrestrial free-living nematodes play essential roles in the decomposition and mineralization of organic matter and recycling nitrogen in the soil and soil food webs, and suppress the densities of plant parasitic nematodes (Rahman et al. 2014; Mendoza-de Gives 2022). The organic amendments in soil systems like green manure and botanical extracts, could significantly reduce the number of plant parasitic nematodes and increase the abundance of bacterial and fungal feeder nematodes (Kekelis et al. 2022). Organic fertilizer applied on the pumpkin (*Cucurbita moschata* (Duchesne) Duchesne ex Poir.) plantation reduces the number of plant parasitic nematodes and increases the non-parasitic nematodes (Atungwu et al. 2018). Applying organic substrates also affected the soil nematode community by increasing the density of bacterivore and fungivore nematodes (Darmola et al. 2013). Diplogasterid predators are abundant in decomposing organic manure soil (Askary and Abd-elgawad 2017). The most abundant population found in organic soil amendments was *Rhabditis* (bacterivore) and *Dorylaimida* (omnivore, excluding plant parasitic nematode and carnivore) (Rahman et al. 2014). Soil nematodes, especially bacterivorous, were the most potential bioindicator agents in soil ecosystem health (Chen et al. 2020; Lu et al. 2020). Terrestrial free-living nematodes could act as bioindicators of soil health due to their response to the soil environmental change like farming, pollution, acidification, insecticide, liming, and fertilization (Sun et al. 2013; Pothula et al. 2019).

Terrestrial free-living nematodes are beneficial organisms that play a role in soil nutrient cycling (Yadav et al. 2018). In the ecosystem, soil nematodes function in decomposition, like bacterivorous nematodes regulate decomposer microflora composition, litter decay rates, and element cycles (Neher 2010). The second role is nutrient cycling, which directly affects nitrogen availability by excreting excess N in the form of ammonium, by the bacterivorous and fungivorous nematode. While indirectly regulating the population of microbivorous nematodes which is done by omnivorous and predatory nematodes (Neher 2010; Buchan et al. 2013;). Bacterivorous and predatory nematodes are performed directly and indirectly for nitrogen mineralization in conventional and integrated farming systems (Yadav et al. 2018). The third role is free-living nematode as disease suppression and biological control (Neher 2010). Omnivorous and predatory nematodes affect plant pests and disease suppression as these nematodes regulate the plant parasitic nematode populations (Bull et al. 2018). Diplogasterid predatory nematodes are suited for biocontrol of nematodes because they are easy to culture, have a short life cycle, have prey specificity, and resistance to adverse conditions (Khan and Kim 2007), while Mononchidae is unsuccessful for biocontrol due to the scarcity and long-life cycle (Neher 2010). In addition, nematodes belonging to genera of *Steinernema* and *Heterorhabditis* could act as biocontrol agents as entomopathogenic nematodes (Askary 2010).

The important role of free-living nematodes has not been explored in the agricultural ecosystem, while the most reported nematode was in plant feeder or plant parasitic nematodes, which caused a detrimental loss in plant productivity. Studies on terrestrial free-living nematode in Indonesia has been reported in the coffee plantation, which depicted several genera of free-living nematodes, i.e., *Dorylaimus, Rhabditis, Aphanolaimus, Aphelenchus, Acrobeles,* and *Mononchus* (Widowati et al. 2014; Tarno et al. 2021). However, there was no information on terrestrial free-living nematodes in potato plantations. Therefore, this study aimed to investigate the diversity and abundance of terrestrial free-living nematodes in potato agroecosystems. This research was necessary to assess the land sustainability for agroecosystems caused by implementing agronomic management practices. Evaluating the presence of terrestrial free-living nematodes could also be used as a fundamental term to manage further agroecosystems to minimize the risk of attacking of plant pests and diseases. Information on the abundance and diversity of terrestrial free-living nematodes could be used to determine the agroecosystem condition and as environmental monitoring.

## MATERIALS AND METHODS

### Study area and soil sampling

The research was conducted at Pratin Village, Serang Sub-district, Purbalingga District, Central Java, Indonesia, in two fields with different varieties (Granola and Atlantik). This location was one of the centers of potato plantations in Central Java. Samples were taken on November 2022 by randomly taking ten potato rhizosphere soil samples from each site. The number of samples taken was based on the land area. Mulyadi (2009) stated in the land area of less than 500 m$^2$, it needs eight to ten soil samples.

### Procedures

*Nematode extraction and isolation*

The rhizosphere soil samples (100 g) were extracted and isolated using the modified Whitehead and Hemming tray method (Bell and Watson 2001) with the component arrangement (top-bottom): tissue paper, nylon gauze, suspension tray, and container tray. The rhizosphere soil samples were laid on the tissue paper and spread evenly. The container tray was filled with water until the soil sample on the top surface was submerged. The rhizosphere soil samples were incubated for 24 hours; subsequently, the water in each container tray was decanted and filtered by a 400 mesh (37 μm) sieve and put into the sample bottle for further observation. The rhizosphere soil samples from each variety were extracted three times.

*Nematode population observations and identification*

Nematode suspension was homogenized using a syringe and poured into the counting dish at about 5 mL. The observation was carried out by a stereo microscope for counting the nematode population and a binocular microscope (400x) for morphological observation. Nematode preservation was carried out using a non-permanent mount by dripping sterile water into the slide and placing the nematode into the slide; then, it was briefly burned using a Bunsen burner. Morphological identification was done by an online identification key accessed at https://nematode.unl.edu/key/nemakey.htm from the University of Nebraska-Lincoln (UNL) Nematology Lab. Morphological characters for nematode identification were stoma, esophagus, tail shape, and another specific morphological character for each genus following the identification key. Nematode populations were calculated by multiplying the mean number of individuals in each genus with the total volume of the sample.

### Data analysis

Data of nematode population densities on each field were tested for normality assumption using the Shapiro-Wilk test ($p = 0.898$; $p > 0.05$ for Granola field and $p = 0.931$; $p > 0.05$ for Atlantik field), subsequently analyzed using T-test at 5% error level. In addition, nematode diversity was evaluated by Shannon-Wiener Index (H'), Evenness index (E), and Simpson's dominance index (D) (Tarno et al. 2021). The statistical software used for data analyses was IBM SPSS Statistics 25 and R Statistic version 4.2.1.

## RESULTS AND DISCUSSION

### Nematode diversity

Results on the nematode diversity based on morphological character refer to the online identification key by UNL Nematology Lab. encountered from potato plantation revealed that there were five genera, i.e., *Diplogaster, Dorylaimus, Tripyla, Lotonchus,* and *Rhabditis*. Nematode genera found in the Granola potato plantation were *Diplogaster, Dorylaimus, Tripyla*, and *Lotonchus*, while in the Atlantik plantation only two genera, i.e., *Dorylaimus* and *Rhabditis*. These five nematodes were categorized as non-parasitic nematodes.

*Diplogaster* (Figure 1)

Below are the steps followed using an online identification key (https://nematode.unl.edu/key/nemakey_pt2.htm) for *Diplogaster*:

1. Cephalic setae indistinct or absent
2. Stylet absent
39. Esophagus expanded at mid-region
49. Lip region without rib-like armature …… *Diplogaster*

*Diplogaster* was categorized as a microbial feeder and predator which fed on other nematodes, bacteria, fungi, and ciliates (Bajaj and Kanwar 2015; Hodda 2022). *Diplogaster* has a large and strong stoma with a strong claw-like movable dorsal tooth to grind the prey (Figure 1.A) (Mendoza-de Gives 2022). Male and female tail usually filiform (Figure 1.B) (Sudhaus and Rehfeld 1990; Kanzaki et al. 2014). The cuticle character of the *Diplogaster* on the cuticle lining between stoma and median bulb appears as a set of several longitudinal ridges, and the lumen of the corpus region was wider than isthmus and basal bulb. The life cycle of the *Diplogaster* genera is short and has high fecundity (Bajaj and Kanwar 2015). *Diplogaster* was the most effective nematode's biocontrol regarding its short life cycle at about 8-15 days, ease to culture, specified on prey, chemotaxis sense, and resistance to the harmful condition (Askary and Abd-elgawad 2017). *Diplogaster* is generally found in decomposing organic manure (Askary and Abd-elgawad 2017). Furthermore, *Diplogaster* was found in several rhizospheres like pear, orchards, rice, and soybean plantation (Shrestha and Bam 2015; Musarrat et al. 2016). Some studies (Fauzia et al 1998; Khan and Kim 2005) revealed that *Diplogaster* effectively controlled root-knot nematodes by suppressing the population densities and reducing the root gall formations on tomato plants (Askary and Abd-elgawad 2017).

*Dorylaimus* (Figure 2)

Below are the steps followed using an online identification key (https://nematode.unl.edu/nemakey.htm) for *Dorylaimus*:

1. Cephalic setae indistinct or absent
2. Stylet present
3. Stylet knobs or flanges absent
29. Valvate median esophageal bulb absent
30. Stomal walls not cuticularized
31. Esophagus with basal expansions
32. Posterior third of the esophagus swollen
36. Stylet axial, positioned centrally………… *Dorylaimus*

The morphological character of *Dorylaimus* has a long body length of about 2-9 mm. The cuticle of *Dorylaimus* was thick with longitudinal ridges. The lip region was moderately offset from the body contour (Figure 2.A). *Dorylaimus* has a strong odontostyle with 2-3 times as long as the lip region width. The female tail was elongated to filiform (Figure 2.B) (Vinciguerra et al. 2016). *Dorylaimus* has a piercing and sucking stylet to puncture their prey and remove their content; thus, it could disturb the prey's internal organs (Mendoza-de Gives 2022). *Dorylaimus* was reported as an omnivorous nematode in freshwater, wet moss, and soil habitats (Vinciguerra et al. 2016). Tarno et al. (2021) reported that *Dorylaimus* was a dominant genus found in coffee plantations in Indonesia. The genus was also reported in garlic plantations in Indonesia (Kusuma et al. 2020), wheat roots and soil in Australia, and orange roots in the USA (Alvarez-Ortega and Pena Santiago 2010). In addition, this genus was found in all types of soils, climates, and habitats. *Dorylaimus* has an efficient prey-searching ability, attraction and aggregation activities at the feeding site, and a wide range of predation on plant parasitic nematodes and other soil microorganisms (Askary and Abd-elgawad 2017).

*Tripyla* (Figure 3)

Below are the steps followed using an online identification key (https://nematode.unl.edu/key/nemakey_pt4.htm) for *Tripyla*:

1. Cephalic setae present
69. Post cephalic setae absent
70. Stylet absent
71. Teeth absent, minute or indistinct
72. Esophagus uniformly cylindrical
82. Stoma narrow, elongated, collapsed, or inconspicuous
83. Gonads paired
84. Amphid inconspicuous ……….…………. *Tripyla*

Genus *Tripyla* has a smooth cuticle, head not offset, composed of three large, fairly rounded lips with three circlets of short blunt and inconspicuous amphid. The form of a stoma was like a simple tube, and the esophagus was almost cylindrical (Figure 3.A). The cell of the esophago-intestinal valve was well developed (UNL Nematology Lab 2023). The tail of *Tripyla* on this study was grouped in short-tails with short cephalic setae (Figure 3.B) (Zhao 2009). *Tripyla* was a predaceous nematode that fed on small microbes like bacteria, fungi, rotifers, and unicellular algae; which categorized as a microbial feeder by ingesting them that can be sucked from suspension and requires some processing in the mouth with its teeth to access the contents (Bilgrami and Gaugler 2004; Hodda 2022). This genus was grouped as chewers nematodes which fed on animals of a similar size to the nematode by taking prey into the mouth and then accessing the contents using the teeth (Majdi et al 2016; Hodda 2022).

*Lotonchus* (Figure 4)

Below are the steps followed using an online identification key (https://nematode.unl.edu/nemakey.htm) for *Lotonchus*:

1. Cephalic setae indistinct or absent
2. Stylet absent
38. Teeth present, prominent
39. Esophagus without mid-region expansion
40. Tail-pointed or tapering
41. Male tail without setae
42. Stoma without denticles
45. Tooth anteriorly directed
46. Tooth in the basal part of stoma………… *Lotonchus*

The main characters of this genus have body length 0.8-5.2 µm, have medium to large stoma with a dorsal tooth at the base of stoma (Figure 4.A), pharyngo-intestinal junction tuberculate, the female genital was amphidelphic or monodelphic, spicule on male was more or less arcuate, bifurcate lateral guiding pieces present, and the tail was predominantly conoid or filiform in both sexes (Figure 4.B) (Vu et al. 2021). *Lotonchus* was categorized as a Mononchid nematode which has a strong sclerotized on the stoma or buccal cavity with a large pointed dorsal tooth, small teeth or denticles (Askary and Abd-elgawad 2017; Mendoza-de Gives 2022). The morphological character of the *Lotonchus* group has a large buccal cavity, and the small tooth was located in the basal part of the stoma. The body was large and robust with a smooth cuticle and indistinct striations. The lip region was set off by slight expansion. Esophagus was long, narrowing to a nerve ring at about ¼ of its length and expanding gradually to its base. The tail was curved and elongated ventrally, and it had asymmetrical muscles around the vagina and slender spicules (Khan and Araki 2002). Mononchid nematode is a broad-spectrum predatory that feeds extensively, not exclusively on plant parasitic or other nematodes (Kim 2015).

*Rhabditis* (Figure 5)

Below are the steps followed using an online identification key (https://nematode.unl.edu/key/nemakey_pt2.htm) for *Rhabditis*:

1. Cephalic setae indistinct or absent
2. Stylet absent
38. Teeth absent, minute, or indistinct
50. Esophagus with basal expansions
51. Esophagus expanded at mid-region
55. Gonads paired
56. Stomal walls straight amalgamated
57. Moderately swollen metacorpus, stoma not excessively elongate …………………………………….. *Rhabditis*

The morphological character of the *Rhabditis* genus has an elongated stoma, tiny, open and cylindrical (Figure 5.A). The cuticle was slightly annulated. This free-living nematode has long tail in males and females (Figure 5.B) (Rakhsanpour et al. 2012). *Rhabditis* do not have stylets or teeth, the lips are flat, and the stoma type was funnel-like channels consisting of cheilostom, gymnostom, and stegostom. The metacorpus of this genus was enlarged. The tail tended to be tapered and blunt to the tip (Mirsam et al. 2020). *Rhabditis* is a bacterial feeder that occurs in a wide range of bacteria. Rhabditis was reported on the maize rhizosphere in South Sulawesi, Indonesia (Mirsam et al. 2020).

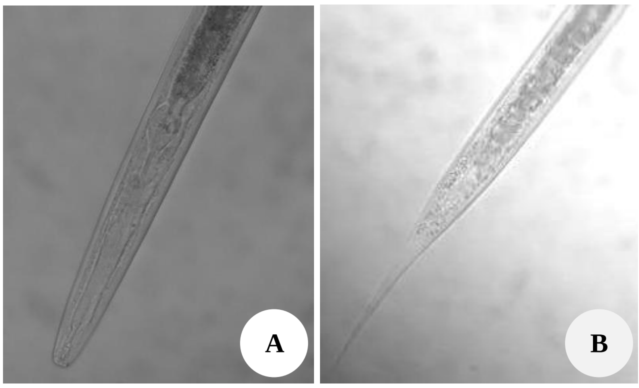


**Figure 1.** *Diplogaster*: A. Anterior; B. Posterior. Note: Microscope magnification 400x

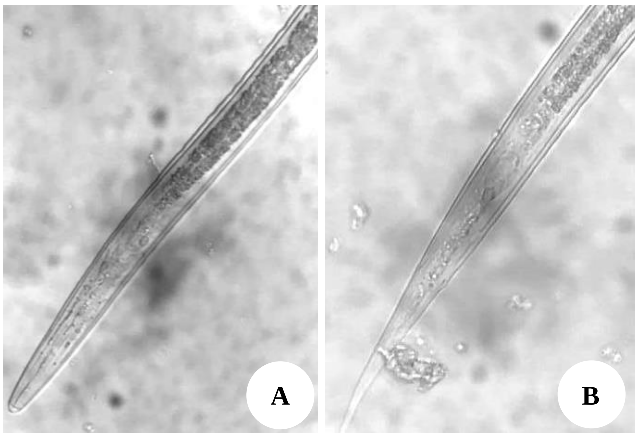


**Figure 2.** *Dorylaimus*: A. Anterior; B. Posterior. Note: microscope magnification 400x

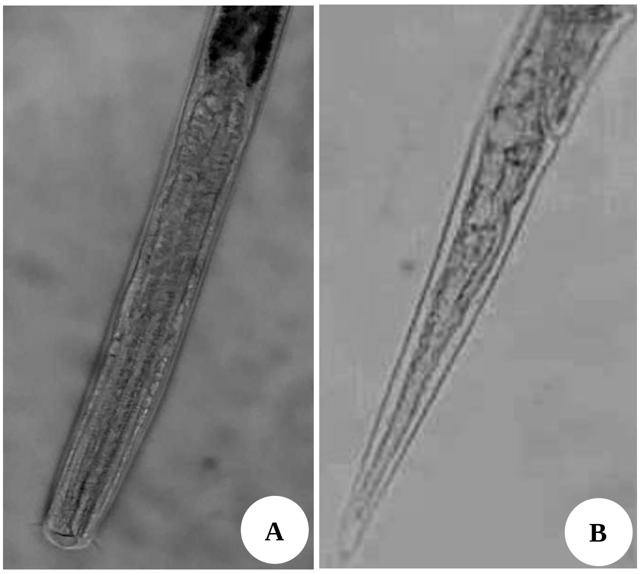


**Figure 3.** *Tripyla*: A. Anterior; B. Posterior. Note: microscope magnification 400x

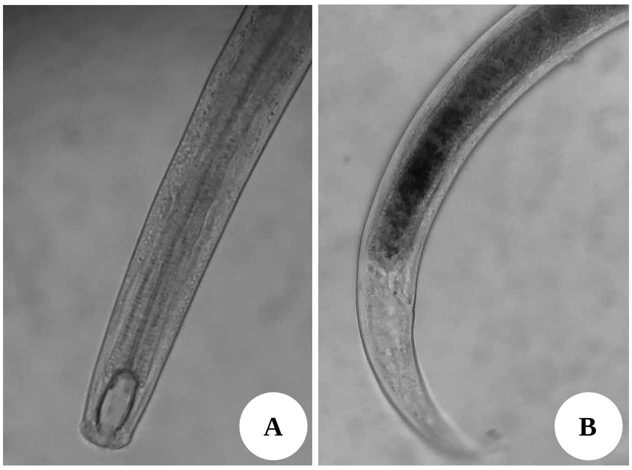


**Figure 4.** *Lotonchus*; A. Anterior; B. Posterior. Note: microscope magnification 400x

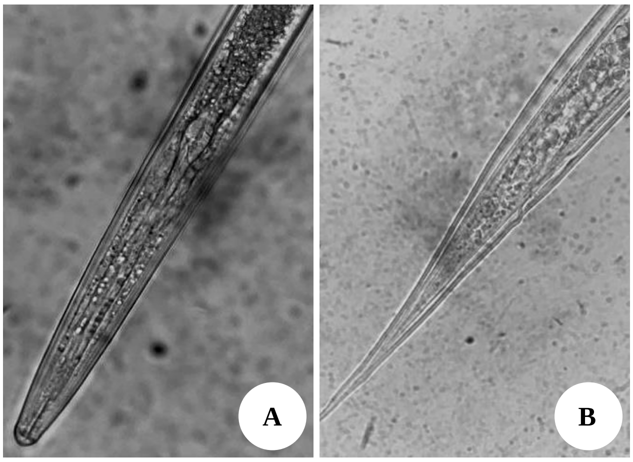


**Figure 5.** *Rhabditis*; A. Anterior; B. Posterior. Note: microscope magnification 400x

## Nematode population

Results of this study depicted that the terrestrial free-living nematode population densities were significantly higher (t = 4.89; P = 0.008) in the Atlantik potato field (918.4 nematode/100 g of soil) than in the Granola potato field (76.53 nematode/100 g of soil) (Figure 6). Terrestrial free-living nematodes found in Atlantik potato field were *Rhabditis* (576.21 nematode/100 g of soil) and *Dorylaimus* (342.21 nematode/100 g of soil), while in Granola potato field were *Diplogaster* (33.21 nematode/100 g of soil), *Dorylaimus* (30.32 nematode/100 g of soil), *Tripyla* (5.77 nematode/100 g of soil), and *Lotonchus* (7.23 nematode/100 g of soil).

*Rhabditis* is a bacterial feeder with specified morphological character on stoma-like tubes or funnels (Mirsam et al. 2020). These terrestrial free-living nematodes in Rhabditida Family also interacted with other soil biota like arthropods and invertebrates. The species of *Rhabditis* associated with insects were *R. terricola* and *Mesorhabditis* sp. (Azizoglu et al. 2016). Slug and snail is also the common host for *Rhabditis;* thus, the slug and snail contribute to the spread of this genus (Sudhaus 2018). *Dorylaimus* was an omnivorous free-living nematode abundantly found in disturbed forest land use (Sagita et al. 2014) and post-coal mine reclamation land in Indonesia (Sofian et al. 2022). Genus *Dorylaimus* could act as a predator, decomposer, and bacterivore (Sofian et al. 2022). *Diplogaster* was a potential predator for plant parasitic nematodes, bacteria, and other soil microorganisms with a high predation rate (Khan and Kim 2005). The feeding habit of *Tripyla* was predatory nematodes which fed on protozoa, small nematodes, and rotifers. Its feeding habit as a predatory nematode was detected by ingested bodies of nematodes and a stylet inside the intestine of *Tripyla* (Asghari et al. 2017). Several species of *Tripyla* have been reported from Mexico and USA i.e. *Tripyla tropica, Tripyla alaecaudata,* and *Tripyla napaensis* (Cid del prado vera et al. 2012). Some species of *Tripyla* were newly found in Northern Iran and North China, i.e., *Tripyla paraffnis* and *Tripyla parafilicaudata* (Asghari et al. 2017) and *Tripyla aquatica* Brzeski & Winiszewska-Slipinska 1993 and *Tripyla setifera* Bütschli 1873, respectively (Liu et al. 2021). *Lotonchus* was a predatory associated with the rhizosphere of medicinal plants in India (Gupta and Mondal 2018). This genus is also found in the rhizosphere of tea plantation in organic, conventional, and semi-natural tea ecosystems, while there were not found in pollution-free tea ecosystems (Li et al. 2014). This predatory nematode is also found in the rhizosphere of the rice ecosystem in India with less population (IARI 2020). In addition, 77 species of *Lotonchus* have been reported, and a new species of *Lotonchus* was identified from the forest in Vietnam, namely *L. lotilabiatus* (Vu et al. 2021).

Regarding the life strategy of these five nematodes, it disclosed that the varieties were not the main factor influencing the abundance of their population in the soil. The nematode's abundance was due to their life strategy not being affected by each variety's root exudate release. Root exudate generally did not impact the activity and growth of free-living nematodes, whereas it was sensitive to the effect on plant parasitic nematodes as herbivorous nematodes (Sikder and Vestergard 2020). Root exudate is mainly affected by the plant parasitic nematode than free-living nematode due to the location of plant parasitic nematodes closer to the root than free-living nematode (Mathesius and Costa 2021).

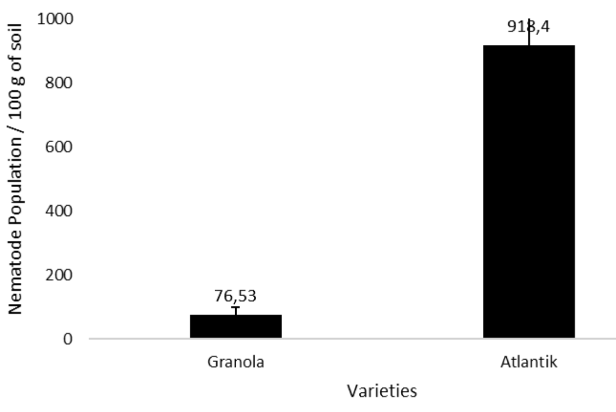


**Figure 6.** The terrestrial free-living nematode population density in different varieties of potato plantation

**Table 1.** Shannon-Weiner (H'), Evenness (E), and Simpson's Dominance Index from Nematode Population in Different Varieties of Potato Plantation

| Varieties | H' | E | D |
|---|---|---|---|
| Granola | 0.80 | 0.85 | 0.49 |
| Atlantik | 0.63 | 0.91 | 0.43 |

Note: Shannon-Weiner Diversity Index: < 1 = low diversity, 1-3 = moderate diversity, > 3 = high diversity; Evenness Index: 0.00 < E < 0.50 = low evenness, 0.50 < E < 0.75 = medium evenness, 0.75 < E < 1.00 = high evenness; Simpson's Dominance Index: 0 < D ≤ 0.5 = no dominance; 0.5 > D ≥ 1 = dominance

In addition, the densities of plant parasitic nematodes respond to the vegetation cover and photosynthetic activity. In contrast, soil properties influenced bacterivore nematodes more (van den Hoogen et al. 2019). In addition, the pesticide application affected the significance of population densities in two fields. The farmer stated that the Granola plantation was intensively sprayed with pesticides, while the Atlantik plantation did not apply pesticides. This condition significantly affected the terrestrial free-living nematode population densities in the soil. That was in line with Khanum et al. (2022), the agroecosystem atmosphere was massive in use of chemical properties like chemical fertilizers and pesticides, adversely affecting beneficial microorganisms and humans. That also affected soil fertility, nutrient disparity, and reduced water holding capacity (Khanum et al. 2022). Yang et al. (2020) stated that pesticides application in the field directly affects soil nematode abundance and diversity. Therefore, bacterivore, fungivore, omnivore, and predator nematodes reach the lowest population in the pesticides (organic phosphate or carbamate) application field (Koc et al. 2020).

The Shannon-Weiner diversity index in both fields was categorized as low diversity, i.e., 0.80 for Granola and 0.63 for Atlantik fields (Table 1). The index value in Granola field was higher than Atlantik field due to the more diverse genera found in Granola field: *Diplogaster*, *Dorylaimus*, *Tripyla*, and *Lotonchus*. In contrast, only two genera were found in Atlantik field, i.e., *Dorylaimus* and *Rhabditis*. The Evenness index value in Granola field was 0.85, and Atlantik field was 0.91 (Table 1), ranging from 0.75 < E < 1.00 and categorized as high genera evenness. The Simpson's Dominance index values were 0.49 for Granola field and 0.43 for Atlantik field (Table 1), indicating no dominance genera in both fields. The abundance and diversity of free-living nematodes are essential in the agroecosystem. The presence of non-parasitic nematodes in the agroecosystem was not only natural enemies that could control some herbivorous insect larvae and plant parasitic nematodes but also contributed to the decomposition process and provided inorganic nutrient availability. Therefore, the abundance and diversity of free-living nematodes could be considered a bioindicator for soil health (Sikder and Vestergard 2020). The ratio of free-living nematode and nonparasitic nematode on the field could be useful as an indicator of soil quality (Rahman et al. 2014). For example, the presence of *Rhabditis* and *Acrobeles* in the soil was positively correlated with the increasing soil nitrogen. Furthermore, the densities of plant parasitic nematodes were also suppressed in the abundant free-living bacterial-feeding nematodes and entomopathogenic nematodes (Khanum et al. 2022).

In conclusion, terrestrial free-living nematodes, categorized as non-parasitic nematodes found in potato plantations, belonged to five genera, i.e., *Diplogaster*, *Dorylaimus*, *Tripyla*, *Lotonchus*, and *Rhabditis*. The abundance of terrestrial free-living nematodes could be used as an indicator of soil health to support plant growth and represent sustainable agriculture. This study could be useful in agriculture regarding the abundance and densities of terrestrial-free living nematode that used as bioindicators and biocontrol. Information about this population could be used to make decisions in future cultivation practices.

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