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Diversity and Population Density of Nematodes in Melons in Bengkulu City

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ABSTRACT: Melon is one of the horticultural commodities with relatively high economic value and is profitable to cultivate as a source of income for farmers. With the increasing demand for melons, melons are widely cultivated in Bengkulu. Pests and diseases are one of the most disturbing problems in melon cultivation. Plant parasitic nematodes are one of the pests of melon plants that are not paid enough attention to by farmers due to a lack of knowledge about nematodes. Losses caused by nematode attacks on melon plants resulted in decreased production. Information about the types of nematodes is crucial to design an effective control strategy. This study aims to identify the diversity and density of nematode populations on melon plants in the city of Bengkulu. Observation of nematode attacks was carried out directly by observing all parts of the melon plant, especially the roots, and identifying and counting nematode populations. Observation parameters included attack symptoms, types of nematodes, and nematode population densities. This research has been carried out with the results: Symptoms of attack on the ground: stunted plants, languishing, quickly wilted. The symptoms of attack in the soil: Root galls, root wounds, and root rot. There are four types of nematodes, namely Genus: Paratylenchus sp, Meloidogyne spp., Rotylenchulus sp., and Helicotylenchus sp., Paratylenchus sp. population density 131.6; Meloidogyne spp. 86.5 Rotylenchulus sp. 69.7 and Helicotylenchus sp. 47.8.

Keywords: Nematode genus, nematode population, melon

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INTRODUCTION

Melon (*Cucumis melo* L.) is an annual fruit plant from Persia or the Mediterranean, bordering West Asia, Europe, and Africa. Melon plants are a type of pumpkin plant still in the same family as watermelon, cantaloupe, and cucumber (Soedarya, 2010).

Melon (*Cucumis melo* L.) belongs to the Cucurbitaceae family, which includes several other vegetables with important economic value, such as cucumber, watermelon, pumpkin, and chayote.

Melons are primarily cultivated for their edible fruit, which is edible even before ripening; in this case, the fruit is not sweet and can be eaten raw, cooked, or pickled. For the most part, the fruit is harvested when it is ripe, and the high sugar content (mainly sucrose) is highly desirable.

Melon is one of the horticultural commodities with high economic value and is profitable to be cultivated as a source of income for farmers. Melon, with a sweet taste, is a source of vitamins in the diet pattern of the Indonesian people as well as raw materials for processed industries. The short harvest period and the high price of melons make melons a leading business commodity (Pitrat, 2008).

Public nutrition awareness is increasing, increasing demand for fruits, especially melons. Melon is one type of horticultural plant currently widely consumed by the public because it contains high levels of sugar, lycopene, and water. The ingredients in 100 g of melon are 0.6 g protein, 17 mg calcium, 0.045 mg thiamin, 2.4 IU vitamin A, 30 mg vitamin C, 0.045 mg B vitamins, 0.065 mg vitamin B2, 6 mg carbo-

hydrates, niacin 1 mg, riboflavin 0.065 mg, iron 0.4 mg, nicotianida 0.5 mg, water 93 mL, fibre 0.4 g, and calories as much as 23 calories (Siswanto, 2010).

Domestic demand for melons tends to increase yearly, in line with population growth. According to the Central Bureau of Statistics (2020), melon production in Indonesia in 2018, 2019, and 2020 respectively; 118708.00 tons; 122105.00 tons, and 1381777.00 tons and only met around 40% of the national demand, the rest of the needs are met through imports. In Bengkulu, melon production fluctuated in 2018, 2019, and 2020: 331.00 tons, 256.00 tonnes, and 696.00 tonnes (BPS, 2020).

Many Bengkulu farmers cultivate melons to meet the increasing demand for melons. Cultivating melon plants is inseparable from plant-disturbing organisms, which can reduce the quality and quantity of yields and even cause crop failure, affecting farmers. Pests that attack include: *Diaphania indica* Saunders, *D. hyalinata* Linnaeus, and *D. nitidalis* Stoll are the primary pests that attack the leaves and fruit of Cucurbitaceae plants. Everatt et al. (2015), *Myzus persicae, Aphis gossypii, Tetranychus* sp., and *Epilachna* sp., while the diseases that attack: *Erwinia tracheiphila, Fusarium oxysporum, Erysiphe cichoracearum* (mildew flour), *Pseudoperospora cubensis* (mildew dew), *Colletrotrichum lagenarium* (spots fruit), and CMV (Sunarjono, H., 2016) and nematodes which are no less important.

Nematodes *Meloidogyne* spp. It was reported to have attacked melon plants (Ridwan *et al*., 1991). Luc *et al.* (1995) also reported that the most common plant-parasitic nematodes (phytonematodes) that attacked melon plants were *Meloidogyne incognita, M. javanica, and M. Arenaria.* Plant parasitic nematodes are found in guava plantations in Lampung. *Meloidogyne* is a dominant and vital plant parasitic nematode in crystal guava cultivation in Lampung (Nabilah *et al*., 2021).

Plant nematodes severely threaten tropical fruits as they cause serious problems for agricultural productivity and sustainability. Root-knot nematode (*Meloidogyne* spp.) has a destructive effect on avocado (*Persea americana*), kiwi (*Actinidia chinensis*), fig (Fix Carica), papaya (*Carica papaya*) and pineapple (*Ananas comosus*). It causes significant damage to the palm date (*Phoenix dactylifera*) seedlings. Xiphinema is associated with a significant grapevine (*Vitis* sp.) decline and is associated with virus transmission, while *Hemicriconemoides mangiferae* is the main nematode affecting mango (*Mangifera indica*) (Mokrini *et al*. 2023)

Plant parasitic nematodes are one type of pest that needs to be watched out for. Despite its microscopic body size, one type of pest, namely the root-knot nematode, can cause losses due to yield losses ranging from 24-38% in tomato plants, 30-60% in eggplant plants, up to 50% in watermelon plants (Netscher and Sikora, 1990). Besides causing damage to plant tissues, parasitic nematode attacks also help soil pathogen infections from the fungal group bacteria and viruses. Further consequences will exacerbate crop damage and increase yield losses and losses. There has been no report on losses caused by nematode attacks on melons, especially in Bengkulu.

In the preliminary research, symptoms of nematode attack were found on the roots of melon plants in Bengkulu. For this reason, it is necessary to research the types of nematodes that attack and the number of populations for each type of nematode found. This information can later be used for recommendations on its control. This study aims to identify the diversity and population density of nematodes on melon plants in Bengkulu.

RESEARCH METHODS

The study was conducted at five melon plantations in the city of Bengkulu. Nematodes were identified at the Plant Protection Laboratory, Faculty of Agriculture, University of Bengkulu. This research took place from July to December 2022. The research design was carried out non-experimentally by conducting field surveys using the purposive sampling method. The land that will be used as the research location, the land planted with melons, is chosen to have a minimum land area of 5 m x 5 m.

Sampling areas for melon planting are 1. Unib one, 2. Unib two, 3. Kelurahan Pematang Gubernur, 4. Desa Srikuncoro, 5. Kelurahan Surabaya. SA sampling of nematodes was taken from the roots and soil around the roots.

Sampling and Observation of Symptoms

Sampling and observation of symptoms were carried out at five melon plantation locations in the city of Bengkulu, and take one melon planting area for each location. Sampling was carried out diagonally, 10 points were taken per land, and each point was made a plot measuring 2 m X 2 m, and from this plot, 10% of the plant population was taken.

Each plant is taken 100 grams, then mixed so that 300 - 500 grams of soil samples are obtained at each point, and then 100 grams are taken for extraction. As for the root tissue sample, 5 grams were taken for extraction.

Observation of symptoms for sampling based on symptoms above the soil surface, namely abnormal growth, stunted plants, yellowing leaves, and plants usually wither during the day and return fresh in the afternoon. While the symptoms below the soil surface are the roots wound until they rot, and the most obvious is root galls.

Nematode Extraction and Isolation

Nematode Extraction and Isolation were carried out on two types of samples: soil and root tissue. For soil samples targeting ectoparasitic nematodes, namely, nematode bodies do not enter root cells while feeding. Whereas for root samples targeting endoparasite nematodes, namely, the entire nematode body enters the root and lives in the root tissue.

The extraction of nematode isolates from soil and root samples was carried out by centrifugation. The soil sample weighed 100 grams and then put into a beaker, added 100 cc of water and stirred until evenly distributed, then filtered using a 20 mesh (Ø 1 mm) sieve, removing coarse soil particles. The suspension was then decanted three times, then the water obtained was reduced with a filter (Ø 50 µm, 40 µm, and 35 µm). The suspension was then centrifuged for 5 minutes (3000 rpm), after which the precipitated groundwater was removed and replaced with a sugar solution (Bj 1.18), then stirred and centrifuged again for 3 minutes (3000 rpm). Centrifuge results containing sugar solution and nematode suspension were poured into a 20 µm filter and then rinsed with water from a spray bottle,

Meanwhile, the root tissue was cleaned and cut into ± 0.5 cm long. The results of pieces are weighed as much as 10 grams, then blended and added to 100 cc of water. The results of the root tissue blender were poured into a measuring cup, then put into centrifuge tubes, and kaolin powder was added to the volume of the solution up to the neck of the tube. The suspension obtained was centrifuged for 5 minutes (3000 rpm), after which the precipitated water was removed and replaced with a sugar solution (Bj 1.18), then stirred and centrifuged again for 3 minutes. The liquid above the residue was poured into a 20 µm filter and then rinsed with water from a spray bottle, then, the

suspension was put in a small bottle, labelled, and stored in the refrigerator.

Nematode Fixation and Calculating Nematode Populations

The nematode suspension that had been obtained was then fixed using FAA (formalin 40% = 100 ml, glacial acetic acid = 30 ml, 95% alcohol = 20 ml, glycerin = 10 ml, and distilled water = 840 ml) by precipitating the suspension for 15 minutes then reduce the volume until the remaining 20 cc, then pouring the FAA solution heat with a temperature of 70°C - 80°C then left for three days.

Nematodes that have been fixed can then be counted using a plastic counting stick under a microscope. Before calculating the population of each nematode suspension, add distilled water until the volume becomes 100 cc. Then hooked using a nematode fishing rod and put into the circus (grouped by resting position).

The circus containing nematodes was put into a desiccator containing 95% alcohol and then put in an oven at 40°C for 12 hours. After 12 hours, the circus was removed from the desiccator, then poured with Seinhorst I solution (95% alcohol = 950 ml, and glycerin = 50 ml) and partially covered with a glass cover, then put in the oven with a temperature of 40°C for 3 hours. The circus glass is taken and poured with Seinhorst II solution (95% alcohol = 500 ml, and glycerin = 500 ml), then partially covered with a glass cover, and then put in the oven at 40°C for 3 hours, then stored at a desiccator containing CaCo3. After being stored in a desiccator, the nematodes in the circus are hooked up to make preserved preparations.

Preparation of Nematode Preserved Preparations

Nematodes that have been fixed are then prepared by making a circle of paraffin on top of the object glass and then dripping glycerin in the middle of the circle that has been made. Then the nematodes were hooked and placed in an object glass that had been given glycerin. The position of the nematodes was held using glass wool so that the position was in the middle and glass wool as a guide for the location of the nematodes, then covered with a covered glass, then heated on a heating plate. The preparations were glued with nail lacquer.

Nematode Identification

After the preserved preparations are finished, the identification process is carried out. Identification at the genus level was carried out by observing under a microscope and comparing morphology using the identification book Mai and Lyon (1975) and the book on plant parasitic nematodes in subtropical and tropical agriculture M. Luc *et al*. (1995).

Observational Variables

The observed variables are:

1. Symptoms of melon plants due to nematode attack, seen during field observations.
2. The nematode population in 100 grams of soil was counted under a microscope using a plastic count of 100 ml of soil suspension, counted per 10 ml until the suspension was used up.
3. In 10 grams of root tissue, the nematode population was counted under a microscope using a plastic counting 100 ml of the whole root suspension, counted per 10 ml until the suspension was used up.
4. Observation of nematode species, carried out on soil samples to see the type of ectoparasitic nematode and root tissue samples to see the type of endoparasite nematode was carried out by observing under a microscope by comparing their morphology using the identification book Mai and Lyon (1975), as well as a book on plant parasitic nematodes in

subtropical and tropical agriculture M. Luc. (1995).

Data analysis.

Data analysis was carried out descriptively by looking at the identified types of nematodes and the population size, where the nematode population with the highest number was a nematode that has the potential to become a vital parasite on melon plants.

RESULTS AND DISCUSSION

Symptoms of plant parasitic nematode attack on melon plantations

Symptoms of plant-parasitic nematodes attack the soil surface, not visible. The symptoms are often mixed with those of other pathogens or such as nutrient deficiencies. It is why farmers are not aware of attacks from plant parasitic nematodes. Ensure there is a nematode attack; it can be done by uprooting the plants. Plants that have been uprooted are observed for the roots; if the roots show a lot of root nodes, root wounds, or root cavities, it means that plant parasitic nematodes attacked the plant. Symptoms of plant parasitic nematode attack on melon plantations in Bengkulu can be seen below in Figures 1 and 2.

Figure 1. Symptoms of nematode attack on the soil surface

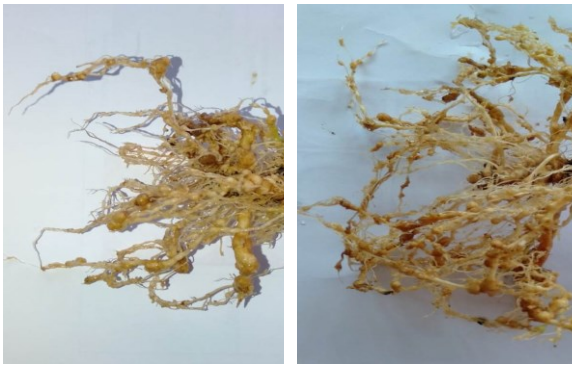

Figure 2. Symptoms of nematode attack on the roots of melon plants

In Figure 2, the melon plant's roots appear to have many root nodes. The presence of root gall causes decreased root function. Nutrients that should be transported to the top of the plant are blocked. So that the plants look stunted, stunted growth, languish, and quickly wither.

Identification Results of Parasitic Nematode Types

The results of a survey on melon cultivation in the city of Bengkulu, as with other melon plants, cannot be separated from plant organism disturbances (OPT), one of which is nematodes. Four genera of nematodes were obtained from the identification that had been carried out on 100 g of soil samples and 5 g of root samples. In all observed fields, there were four genera of this nematode: *Paratylenchus, Meloidogyne*, *Rotylenchulus*, and *Helicotylenchus*. Can be seen in the image below:

Figure 3. *Paratylenchus* sp.

Based on microscopic observations, including small plant parasitic nematodes.

Adults are less than 0.5 mm long—separate sexes. The lip area is indented and shaped like a truncated cone. The style is soft with rounded knobs. The tail is curved ventrally and has no wings. Cuticle annulations are narrow, with fine divisions. In most species, there are four lateral stripes. Paratylenchus hosts and melons are also in pumpkins (Zhao *et al*., 2022).

Figure 4. *Meloidogyne* spp. (Juvenil two Whole body; magnification 100 × 10).

Based on microscopic observation, the nematodes found were Meloidogyne spp. Juvenile 2, elongated cylindrical shape, has a transparent knob (rounded stylet base) and a tapered tail with a tip that looks like a cone.

Nematodes *Meloidogyne* spp. Found in soil and root samples, this is to the literature from Mulyadi, 2009 which states that the nematodes Meloidogyne spp. Juvenile 2 (J2) moves actively in the root tissue and the soil.

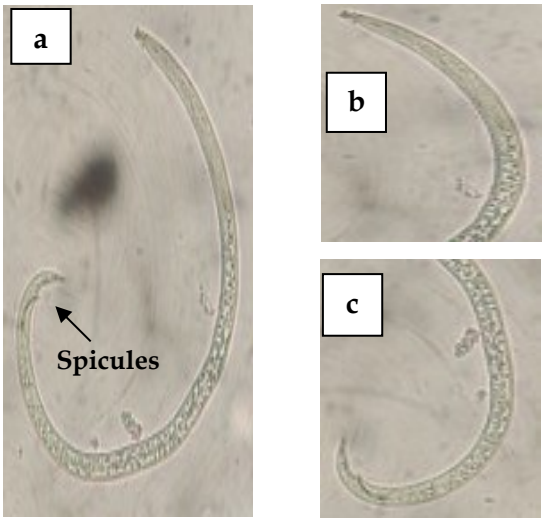

Figure 5. *Rotylenchus* sp.

Based on the observations under a nematode microscope, it was found that the genus *Rotylenchulus* sp. young female with resting body position curved ventrally. Based on observations, the *Rotylenchus* nematode has two genitals in one body simultaneously. The skeletal parts of the head are sclerotized; stylet and oesophagus are reduced but visible. The spicules are curved. The tail is pointed, and the bursa does not reach the tip of the tail. It is to the identification guide Luc *et al.* (1995).

Figure 6. *Helicotylenchus* spp.

In general, the nematodes of the genus Helicotylenchus have a resting position in the form of a spiral or tend to bend, as it has been observed that this nematode, *Helicotylenchus,* has a spiral shape—a nematode of medium size with a blunt conical head.

According to M. Luc *et al*., (1995) female nematodes have their vulva posteriorly (60–70%); generally, both genital tracts are fully grown, as in the observations of the nematodes *Helicotylenchus* spp have two genital tracts posteriorly.

The tail is short and generally conical to convex or hemispherical dorsally in the type of Helicotylenchus spp. There is a bulge at the end of the tail called mucro (Luc *et al*., 1995).

The results of observations and identification that have been carried out on melon plantations in the city of Bengkulu

obtained four genera of plant parasitic nematodes, namely: *Paratylenchus* sp., *Meloidogyne* spp., *Rotylenchulus* sp., and *Helicotylenchus*. Information on parasitic nematodes on melon plantations so far is only from the genus *Meloidogyne* spp. Nematodes *Meloidogyne* spp. It was reported to have attacked melon plants (Ridwan *et al*., 1991). Luc *et al.* (1995) also reported that the most common plant-parasitic nematodes (phytonematodes) that attacked melon plants were Meloidogyne incognita, *M. javanica*, and *M. Arenaria*.

Population density of parasitic nematodes on melon plantations

The results of observations and calculations on soil and root samples on melon plantations in Bengkulu can be seen in Table 1 below.

Table 1. Average population density of parasitic nematodes in 100 grams of soil and 5 grams of melon plant roots.

Observation Location		A genus of plant parasitic nematodes			
		Paratylenchus sp.	*Meloidogyne*s sp.	*Rotylenchulus* sp.	*Helicotylenchus* spp.
Unib 1	Soil	19,2	14,7	14,7	7,9
	Root	13,8	8,8	8,9	4,4
Unib 2	Soil	13,8	8.0	5,5	3,7
	Root	8,7	5,1	2,8	2,3
P. Gubernur	Soil	14,2	9,4	6,2	4,6
	Root	8,8	4,1	4,5	4,3
Srikuncoro	Soil	15,8	10.5	9,4	7,8
	Root	10,1	8,1	3,6	3,3
Surabaya	Soil	16,4	12,2	10,3	4,6
	Root	10,8	5,6	3,8	4,9
Total		131.6	86.5	69,7	47,8

In Table 1. The average population density of parasitic nematodes in 100 grams of soil and 5 grams of roots can be seen in the genus Paratylenchus sp. The most numerous, followed by Meloidogyne spp, then Rotylenchulus sp. and the least is the genus Helicotylenchus sp. These four genera were present at each observation location, indicating that plant parasitic nematodes attacked each observation location. It is necessary to control nematodes in melon plantations because if prevention and control of nematodes are not carried out, the population will increase. The population will quickly increase if melon cultivation is carried out continuously without interspersed with planting other commodities.

Plant parasitic nematodes already present in melon plantations will multiply quickly if food is continuously available. In high nematode populations, it causes melon plants to languish and die. It is not realized by melon farmers in the city of Bengkulu. So it is necessary to do counselling about plant parasitic nematodes and their control on melon plants in the city of Bengkulu. The Study on Melon conducted in Jiangsu Province in China showed that 54 genera of soil nematodes were recorded, with an average abundance of 682 per 100 g dry soil. The dominant genera were *Protorhabditis*, *Acrobeloides*, and *Tylenchorhynchus*. While nematode populations did not change with increasing cultivation years, the abundance of bacterivores and omnivores-predators significantly decreased, and that of plant-parasites increased significantly. They resulted in a gradually increased population

of *Tylenchorhynchus* and *Meloidogyne* (Gao *et al*. 2020).

CONCLUSION

Symptoms of attack on the ground: stunted plants, languishing, quickly wilted—the symptoms of attack in the soil: Root galls, root wounds, and root rot. The nematode genera identified in the five melon plantations observed in Bengkulu City were four genera. The population density of parasitic nematodes, namely: *Paratylenchus* sp. 131.6, *Meloidogyne* spp. 86.5, *Rotylenchus* sp. 69.7, and *Helicotylenchus* sp. 47. The relatively high population density is the genus *Paratylenchus* sp. and *Meloidogyne* spp., so these two genera are essential in melon cultivation.

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