Morphological characteristic of *Fusarium* spp. in several highlands of North Sumatera

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**Abstract.** *Fusarium* spp. is a genus of fungi that causes disease in many plants so that special attention, handling and control is needed for this pathogen. Morphological observations are needed to provide an overview of macroscopic and microscopic morphological variations that be used as basic information in the development of a *Fusarium* spp. control program. The research aims to determine the morphological characteristics of *Fusarium* spp. in several highlands of North Sumatra. The research was conducted at the Laboratory of Plant Diseases, Faculty of Agriculture, Universitas Sumatera Utara, Medan in September-December 2019. *Fusarium* spp. isolates obtained from several highlands of North Sumatra were rejuvenated on Potato Dextrose Agar (PDA) medium. All isolates were observed macroscopically and microscopically to determine colony morphology including macroconidia, microconidia and conidiophores. Microscopic morphological observations using a compound microscope. The results showed that *Fusarium* spp. obtained have almost the same morphology. Microscopic observation showed that there were differences in macroconidia morphology in *Fusarium* spp. isolates found in Tanah Karo District with Simalungun and Dairi Districts.

1. **Introduction**

*Fusarium* spp. is a genus of fungi that causes disease in many plants, including tomato [1]. It is included in the Turberculariaceae family because in nature this fungus forms a conidium-forming fruiting body called a sporodocium [2]. *Fusarium* spp. form three types of asexual spores, namely microconidia, macroconidia, and chlamydospores [3]. Fungi consisted of several races and strains with different levels of virulence and have the ability to survive in the soil without a main host for up to 40 years [4]. *Fusarium* wilt disease can reduce tomato production by up to 30%, even in the rainy season it can reach 60% [5].

*Fusarium* diversity is quite high, including *F. oxysporum*, *F. camptoceras*, *F. concentricum*, *F. musarum*, *F. proliferatum*, *F. semitectum* (*F. pallidoroseum*, *F. incarnatum*), *F. compactum*, *F. thapsinum*, *F. verticillioides* and *F. subglutinans* [6]. High genetic diversity of a population can occur due to mutations, gene recombination, sexual and parasexual reproduction, selection factors, and gene migration from one place to another [7].

Identification of *Fusarium* spp. in simple terms can be done by observing morphologically. Simple observations by looking at morphological characters are needed to provide an overview of macroscopic and microscopic morphological variations [8]. Therefore, identification is needed to determine the
morphological characteristics of *Fusarium spp.* which causes wilt disease in tomato plants, especially in some highlands of North Sumatra.

2. Materials and methods

The research was conducted at the Laboratory of Plant Diseases, Faculty of Agriculture, Universitas Sumatera Utara, Medan in September-December 2019. The materials used in this study were stem and root tissue of tomato plants and soil samples from the rhizosphere of tomato plants infected with *Fusarium spp.* in the highlands of North Sumatra, namely the districts of Karo, Simalungun and Dairi.

2.1. Field sampling

Sampling was carried out in tomato farms located in the highlands of North Sumatra, namely Karo, Simalungun and Dairi districts. The sampling location was carried out in a composite manner, namely 2 villages for each district. Samples were taken from the stems and roots of tomato plants that showed wilting symptoms, while soil samples were taken as a composite at 5 points in the rhizosphere of tomato plants. Each point of soil sampling was carried out randomly using the Simple Random Sampling (SRS) method [9]. Soil samples taken were then homogenized and 1 g was taken as a sample.

2.2. *Fusarium* spp. isolation

The stem and root tissue of diseased tomato plants were cut at 1 cm in length, then sterilized with 70% alcohol and rinsed with sterile distilled water. The samples were grown in sporulation medium and incubated for 3–5 days at room temperature.

Isolation of *Fusarium* spp. from rhizosphere soil was carried out by serial dilution technique up to $10^{-5}$. 1 g soil sample is diluted with 9 ml and shaken using an orbital shaker for 3 minutes. 0.1 ml of each $10^{-3}$ to $10^{-5}$ dilution was separately plated on the PDA medium.

Fungi colonies were observed using a compound microscope every day for seven days after washing (DAW). Colonies with suspected *Fusarium* spp. morphology which have macroconidia, microconidia, and chlamydospores were purified on PDA medium to maintain virulence and stored for further testing.

2.3. Morphological diversity test

*Fusarium* spp. colonies were be sub-cultured on PDA medium and incubated at room temperature for 5 days. Microscopic morphological observations include the forms of macroconidia, microconidia, and conidiophores were carried out with a microscope.

3. Results and discussion

Exploration of *Fusarium* spp. in tomato farms in the highlands of North Sumatra found *Fusarium* spp. 6 isolates. They were 2 isolates from Tanah Karo district, 2 isolates from Simalungun District, and 2 isolates from Dairi District. The isolates from Tanah Karo and Simalungun Districts got from the root and stem tissue of tomato, while isolate from Dairi District got from *Fusarium* spp. infected rhizosphere soil samples.

The results of microscopic observations showed that there were morphological similarities between isolates of *Fusarium* spp. Generally, the morphology of *Fusarium* spp. was found to have purplish-white mycelium, long/short macroconidia, oval-shaped microconidia and long/short conidiophores and forming chlamydospores (Table 1). In PDA medium, the fungal colony grows rapidly and the white aerial mycelium may rapidly become reddish, purple or appear blue in the sclerotium when it forms in large numbers or with a cream to yellowish-brown colour and then turns orange if it is sporodochial abundant [10-12].
Table 1. Morphological characteristics of each isolate of *Fusarium spp* from Tanah Karo, Simalungun and Dairi Districts

| No. | Origin of isolate | Code of isolates | Characteristic |
|-----|-------------------|------------------|----------------|
| 1   | Kaban Village, Kabanjahe sub-district, Tanah Karo District | Tom-1 | Mycelium is purplish-white, long curved macroconidia with a narrow tip, insulated, consisted of 6-9 septa |
| 2   | Sampun village, Brastagi sub-district, Tanah Karo District | Tom-2 | Mycelium is purplish-white, insulated macroconidia, consisted of 1-3 septa, short conidiophore and unbranched, oval microconidia |
| 3   | Nagori pematang raya village, Raya sub-district, Simalungun District | Tom-3 | Mycelium is purplish-white, long conidiophore and unbranched, oval microconidia |
| 4   | Nagori tongah village, Purba sub-district, Simalungun District | Tom-4 | Mycelium is purplish-white, long curved macroconidia with a narrow tip, non-insulated |
| 5   | Sumbul village, Lea Parira sub-district, Dairi District | Tom-5 | Mycelium is purplish-white, long macroconidia and non-insulated, short conidiophore and unbranched, oval microconidia are abundant, forming chlamydospores |
| 6   | Parbuluan I village, Parbuluan sub-district, Dairi District | Tom-6 | Mycelium is purplish-white, macroconidia and non-insulated, short conidiophore and unbranched, oval microconidia are abundant, forming chlamydospores |

Figure 1. Microscopic of *Fusarium spp* from Tanah Karo, Simalungun and Dairi District: (1) Tom-1, (2) Tom-2, (3) Tom-3, (4) Tom-4, (5) Tom-5, (6) Tom-6, with the following morphological sections: (a) conidiophores, (b) microconidia, (c) macroconidia.
The microscopic morphological observations showed that the most morphological characters found in *Fusarium* spp. were microconidia and macroconidia. However, there were differences in the morphology of microconidia and macroconidia at all isolates (Figure 1). Tom-1 and Tom-4 isolates have no microconidia, while at Tom-2, Tom-3, Tom-5 and Tom-6 isolates there was an oval microconidia. Besides, Tom-1 and Tom-2 isolates had insulated macroconidia morphology, Tom-4, Tom-5, Tom-6 isolates had non-insulated macroconidia morphology and Tom-3 isolates did not have macroconidia. According to [13], microconidia is formed in a chain structure, usually single-celled, sometimes 2-celled. Macroconidia is also formed, sometimes rarely.

Microscopic observations showed that only Tom-6 isolates formed chlamydospores. Chlamydospores are formed separately or in pairs. Chlamydospores are not formed, either in the mycelium or in the conidium. Often the mycelium forms a dark blue, irregularly rounded sclerotium [14].

Morphological differences were also can be seen in the morphology of conidiophores, where the Tom-2, Tom-5, Tom-6 isolates had short and unbranched conidiophores, and Tom-3 isolates had long and unbranched conidiophores, whereas Tom-1 and Tom-4 isolates has no conidiophores.

Isolate of *Fusarium* spp. obtained from several tomato gardens in the highlands of North Sumatra have several morphological differences between isolates found in one area with other areas. This is a characteristic of each *Fusarium* spp. isolate found in each region. The results of research [15], isolates of *Fusarium* spp. cannot be clearly distinguished at the level of species or specialist form based on colony colour. Meanwhile, microscopic observation can only distinguish isolates of *Fusarium* spp. at the species level only, while the forma specialis level cannot be distinguished.

4. Conclusions
Isolate of *Fusarium* spp. obtained from the exploration of several tomato plants infected with *Fusarium* spp. in the highlands of North Sumatra has almost the same morphology. Microscopic observation showed that there were differences in macroconidia morphology in *Fusarium* spp. isolate found in Tanah Karo District with Simalungun and Dairi Districts.

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