Spore dimensional characteristics of *Peronosclerospora sp.* from corn leaves informer of sugar cane plantation

Hasanuddin

Faculty of Agriculture, Universitas Sumatera Utara, Medan, Sumatera Utara, Indonesia.

E-mail: *hasanuddiny@yahoo.com

**Abstract.** Corn and sugar cane are two types of plants that have the same host of the pathogen *Peronosclerospora sp* as cause of a seriously downy mildew disease. So that replacing sugar cane cultivation with corn plant is somewhat unfavourable. In Indonesia, downy mildew causes a yield loss of 50-100% on susceptible varieties. In this study, have been done a collection of spores from corn leaves infected with *Peronosclerospora sp.* from community corn cultivation who planted on PTPN2's former of sugar cane field, namely Sei Mencirim Sunggal village and from corn plant who growth on community land non former of sugar cane from Lau Bekri village, Pancur Batu village, and Tanjung Anom Deli Serdang village. The objective of this study was to find out the characteristics of the spores’ dimension of *Peronosclerospora sp.* which has infected corn leaves from different source area as mention above. The results computation of ratio length and width of the spore’s origin of Pancur Batu is 1.35 ± 0.19, Lau Bekri 1.24 ± 0.1, and Tanjung Anom 1.27 ± 0.14, these ratios shown that the dimensions of spores are subspherical, while the ratio spores origin from Sei Mencirim is 1.02 ± 0.05 or shown spherical dimension shape.

**1. Introduction**

The company PT Perkebunan Nusantara 2 (PTPN2) is the only State-Owned Enterprise that operates sugar cane as an annual crop cultivation in North Sumatra. The purpose of the development of sugar cane plantations in North Sumatra is as an effort to overcome the shortage of sugar for domestic consumption and industry and reduce dependence on imported sugar. PTPN2's dry land sugar cane is spread in two regencies, namely Langkat and Deli Serdang, reaching 5,365 ha. To support the white sugar production process two sugar factories have been built, the Sei Semayang Sugar Factory built in 1982 and the Kwala Madu Sugar Factory built in 1983.

In a changed of interests, in the early of 2000s there was land occupation by community on sugar cane land plantation belong to PTPN2, especially on sugar cane fields adjacent to the village where the community lived. The arable lands are planted with seasonal crops such as corn. Considering that corn and sugar cane are two types of plants that have the same host of the pathogen *Peronosclerospora sp* as cause of a seriously downy mildew disease, So that replacing sugar cane plants with corn from the side of the development of plant diseases is somewhat unfavourable because both of these plants can attacked by the same pathogen each other and become hosts for growth or evolution. Then It is suspected that the community's corn that grown in the arable land of the former of sugar cane plant has been infected with the *Peronosclerospora sp.* which has been infecting sugar cane before. Cause of it
is necessary to study an outbreak of the species *Peronosclerospora* sp. which has infected corn who planted in former of sugar cane cultivation land.

Downy mildew diseases have been one of the causal agents for corn yield loss that which caused by oomycetes of *Peronosclerospora*. The disease occurs at every stage of corn plant growth, from seedling until harvesting. Downy mildew has the potential to reduce up to 30% of the total corn production worldwide [1]. In Indonesia, downy mildew causes a yield loss of 50-100% on susceptible varieties [2].

In this study, have been done a collection of spores from corn leaves infected with *Peronosclerospora* sp. from community corn cultivation who planted on PTPN2’s former of sugar cane field, namely Sei Mencirim Sunggal village and from corn plant who growth on community land non former of sugar cane from Lau Bekri village, Pancur Batu village, and Tanjung Anom Deli Serdang village. The objective of this study was to find out the characteristics of the spores of *Peronosclerospora* sp. which has infected corn leaves inorder of sugar cane fields and compared with the characteristics of the *Peronosclerospora* sp spores infecting corn leaves in non-former of sugar cane fields to prove that it is true that there has been a *Peronosclerospora* sp infection to corn leaves that originating from sugar cane as a previously host.

2. Material and method

2.1. Collection of corn leaf samples

*Peronosclerospora* sp. infected corn leaves were taken from four sample locations from maize plants aged 40-50 days or still in the vegetative growth phase by cutting the third leaf from the shoots that clearly showed symptoms of pathogenic infection. Leaf sample is cut short between 20-25 cm and put into a plastic bottle that has been filled with 15 ml of 2% sugar water solution, the position of the leaf in the bottle with the basal part below and the top part above. The collection of leaves from the field is carried out early in the morning at 06.00-07.00 or before the sun rises. The plastic bottle packaging is then stored in a cooler box to be brought to the laboratory. The temperature of the cooler box is kept at around 20°C by adding ice crystals.

2.2. Slide preparation

The leaves were brought inside laboratory, removed from the packaging bottle and placed on a table with the leaf surface was facing up. Using a flashlight, the surface of the leaf was observed for the presence a lot of mass of spore of *Peronosclerospora* sp as indicated by the presence of white powder on the leaf surface. The spores were collected by attaching clear sticky tape to the leaf surface and placed onto a glass object containing a drop of methylene blue. The clear sticky tape was sealed using clear nail polish and kept for further microscope analysis [3]. The oomycete of downy mildew was characterized by measuring the spores’ dimensions using an “OptiLab Advance” hardware and software Digital Microscopes Camera. The first 25 undamaged spores found under the microscope were assessed. The dimensions of spores (length and width, x400) were measured.

3. Results and discussion

3.1. Results

Corn leaf samples that had been collected from the planting site, after incubating for one night showed the appearance of white spore masses on the leaf surface. The mass of the spores is taken from each leaf sample for slide preparation and observed with a compound microscope and digital camera. Microscopic observation of spore dimensions based on the length and width of 25 intact spores at 400x magnification and the ratio of length and width shows that the spore dimensions show variations between spherical and subspherical.

The results of ratio computation of the length and width of the spores of *Peronosclerospora* sp. origin of Pancur Batu 1.35 ± 0.19 (Figure 1), origin spore of Lau Bekri 1.24 ± 0.1 (Figure 2), and
Tanjung Anom $1.27 \pm 0.14$ (Figure 3), the ratio of length and width of the three spores above shows that the dimensions of spores are subspherical, while the ratio of the length and width of the Peronosclerospora sp spores from Sei Mencirim (corn cultivation in the area of the former sugar cane plantation) ranges from $1.02 \pm 0.05$ (Figure 4) or shows spherical dimension shape because the ratio of length and width is almost close to 1.0. Next complete data on the results of microscopic counts as shown in Table 1 below.

**Table 1.** Spores dimensional characteristics of *Peronosclerospora* sp. from corn leaves

| Source of spore Area | GPS               | Length (µm) | Average | L/W        |
|----------------------|-------------------|-------------|---------|------------|
| Pancur Batu          | (3.4518N, 98.6035E) | 18.06 ± 2.68 | 13.47 ± 1.74 | 1.35 ± 0.19 |
| Lau Bekri            | (3.5199N, 98.5742E) | 19.23 ± 0.73 | 15.63 ± 1.41 | 1.24 ± 0.10  |
| Tanjung Anom         | (3.5207N, 98.5758E) | 19.83 ± 1.75 | 15.75 ± 1.80 | 1.27 ± 0.14  |
| Sei Mencirim         | (3.5911N, 98.5281E) | 18.36 ± 2.07 | 17.99 ± 2.04 | 1.02 ± 0.05  |

*Figure 1.* Photomicrograph spores of *Peronosclerospora* sp. from Pancur Batu Area. Mag 400 x

*Figure 2.* Photomicrograph spores of *Peronosclerospora* sp. from Lau Bekri Area. Mag 400 x

*Figure 3.* Photomicrograph spore of *Peronosclerospora* sp. from Tanjung Anom Area. Mag 400 x

*Figure 4.* Photomicrograph spores of *Peronosclerospora* sp. from Sei Mencirim Area (former of Sugar Cane Plantation). Mag. 400x
3.2. Discussion

The results of microscopic observations and measurements of the dimensions of the spores of the four origin area of the spread infection from Peronosclerospora sp show that the spores from maize from ex-sugar cane areas show that the dimensions of the spore are firmly spherical in which the ratio of the length and width of the spores is almost the same (equal to 1), while the comparison of the length and width of the spores from maize originating from land not former sugar cane plantations showed subspherical dimensions of spores that are almost ellipsoid, these results indicate that the dimension characteristics of the spores Peronosclerospora sp. from the corn plantations from the former sugar cane fields have a distinctive character dimension that is different from the spores from the other three sources.

In Indonesia, there have been reported to be three species of Peronosclerospora sp that infect corn plants, which are P. maydis, P. philippinensis, and P. sorghi [3][4][5]. Two of the three Peronosclerospora sp species, namely P. sorghi and P. philippinensis are included in the A2 category quarantine plant-disturbing organisms (OPTK A2 category) that mean which is reported as OPTK in the territory of Indonesia but is limited to certain regions [6]. P. maydis caused of Java downy mildew was the first Peronosclerospora sp. downy mildew pathogen described on maize and nearly 100% losses have been reported to late-plant maize due to this pathogen [7]. A maize strain of P. sorghi, perhaps existing only in Thailand, rarely infects sorghum but has caused large losses to maize in that country [8]. Isozyme and epidemiological studies suggest that the maize strain is distinct from other downy mildew pathogens and perhaps should be considered a separate species [9]. P. philippinensis and P. sacchari were indistinguishable from one another on the basis of amount of sporulation, the mean spore volume for both species did not differ significantly, and original basis for classifying report that P. philippinensis did not infect sugar cane, whereas P. sacchari did [10]. According to Sun, P. sacchari has been a serious disease of both sugar cane and maize, particularly in Taiwan. Although the disease is readily transmissible between maize and sugar cane, whereas maize is usually more susceptible [11]. Morphologically, symptoms, host range, and isozyme comparisons strongly suggest that P. philippinensis is closely related to, or the same as, P. sacchari [8].

4. Conclusion

The dimensional characteristics of the Peronosclerospora sp spores from corn sources planted in former-sugar cane fields in Sei Mencirim shows that the spore dimensions are spherical and different from the spores from Lau Bekri, Tanjung Anom, and Pancur Batu whose spores dimensions are subspherical forms. These results indicate that there has been a transmissible infection of P. sacchari as cause of downy mildew disease from sugar cane as a previous host in the same land to corn as existing plant in the field at present. This can occur because P. sacchari, which attacks sugar cane, morphologically, symptoms, host range and isozyme comparisons is closely related to or the same as P. philippinensis that attacks corn too.

References

[1] Rashid Z, Zaidi P H, Vinayan M T, Sharma S S and Setty T A S 2013 Downy mildew resistance in maize (Zea mays L.) across Peronosclerospora species in lowland tropical Asia, J. Crop Protection 43 183-91

[2] Widianifini F, Yulia E and Purnama T 2015 Morphological Variation of Peronosclerospora maydis, the Causal Agent of Maize Downy Mildew from Different Locations in Java-Indonesia Journal of Agricultural Engineering and Biotechnology 3 2 23-7

[3] Burhanuddin 2011 Identifikasi cendawan penyebab penyakit bulai pada tanaman jagung di Jawa Timur dan Pulau Madura [Identification of fungal pathogen the causal agent of maize downy mildew in East Java and Madura Island] Suara Perlindungan Tanaman 1 21-6

[4] Hikmahwati, Kuswinianti T, Melina and Pabendon M B 2011 Karakterisasi morfologi Peronosclerospora spp. penyebab penyakit bulai pada tanaman jagung dari beberapa daerah di...
Indonesia [Morphological characteristics of Peronosclerospora sp. the causal agent of maize downy mildew from several regions in Indonesia] Jurnal Fitomedika 7 159-61

[5] Wakman W and Hasanuddin 2003 Penyakit bulai (Peronosclerospora sorghi) pada jagung di dataran tinggi Karo Sumatera Utara [Downy mildew disease (Peronosclerospora sorghi) in maize in the Karo highlands of North Sumatra] National Seminar on the Indonesian Phytopathology Association (PFI) in Bandung

[6] Surtikanti 2012 Penyakit Bulai pada Tanaman Jagung [Downy mildew disease in maize plants] Proc. of the Scientific Seminar and Annual Meeting of PEI and PFI XXI Komda Sul-Sel, Makassar pp 41-48

[7] Semangun H 1970 Studies on downy mildew of maize in Indonesia, with special reference to the perennation of fungus Indian Phytopathol 23 307-20

[8] Yao C L, Magill C W, Frederiksen R A, Bonde M R, Wang Y and Wu P S 1991 Detection and identification of Peronosclerospora sp sacchari in maize by DNA hybridization Phytopathology 81 901-05

[9] Micales J A, Bonde M R and Peterson G L 1988 Isozyme analysis and aminopeptidase activities within the genus Peronosclerospora sp Phytopathology 78 1396-402

[10] Duck N B, Bonde M R, Peterson G L and Bean G A 1987 Sporulation of Peronosclerospora sp sorghi, P. sacchari, and P. phillippinensis on maize Phytopathology 77 438-41

[11] Sun M H 1970 Sugarcane downy mildew of maize Indian Phytopathol 23 262-9