TARC Notes

Dispersion of conidia of *Sclerospora maydis* in outbreaks of maize downy midew disease in Indonesia

Maize, an important food crop next to rice in Indonesia, often suffers from the Java downy mildew. As this disease causes serious crop damage, often resulting in a complete crop failure, how to control the disease is a key problem for the maize production.

The primary infection of *Sclerospora maydis*, a pathogene of the disease, is known to occur through infected seeds although some other means of infection are presumed. The secondary infection depends on the conidia produced on the primarily infected plants. The primary infection does not cause much damage to the crop, but the secondary disease with more than 90% of the plants severely infected. It is, therefore, very important to know the extent of the areal dispersion of the causal conidia in order to establish effective control measures. Palm (1918)[5] reported that the pathogenic conidia could reach more than 2 km by air-borne dispersion, although no experimental evidence was shown.

The authors conducted two experiments to know the range of infection caused by the dispersed conidia. Experiments were carried out at the Cikeumeuh Plant Station of the Central Research Institute for Agriculture in Bogor, Indonesia, from 1971 to 1973.

In the first experiment, maize was sown in a single row on 10th of October 1972, and, after germination, the plants were inoculated with the pathogene and used as an infection source. In parallel with this row, another 12 rows (10 m in length for each) were prepared at the distance of 3–16 m from the infection source.

Bogor composite 2 was sown on these 12 rows at 20 cm of spacing on 2nd of November.

The seed germination began on 6th, and the first leaf development ended on 8th of November. The first systemic symptoms appeared on 15th of November.

Plants showing systemic symptoms were counted on 20th and 21st of November. This experiment was conducted with 7 replications.

The climatic condition in November at Bogor was adequate for the growth of maize and the disease infection, i.e., maximum temperature: 31.5°C, minimum temperature: 21.5°C, average temperature: 25.7°C, precipitation: 594 mm, sunshine rate: 70%, air humidity: 66% in daytime and 95% at night,

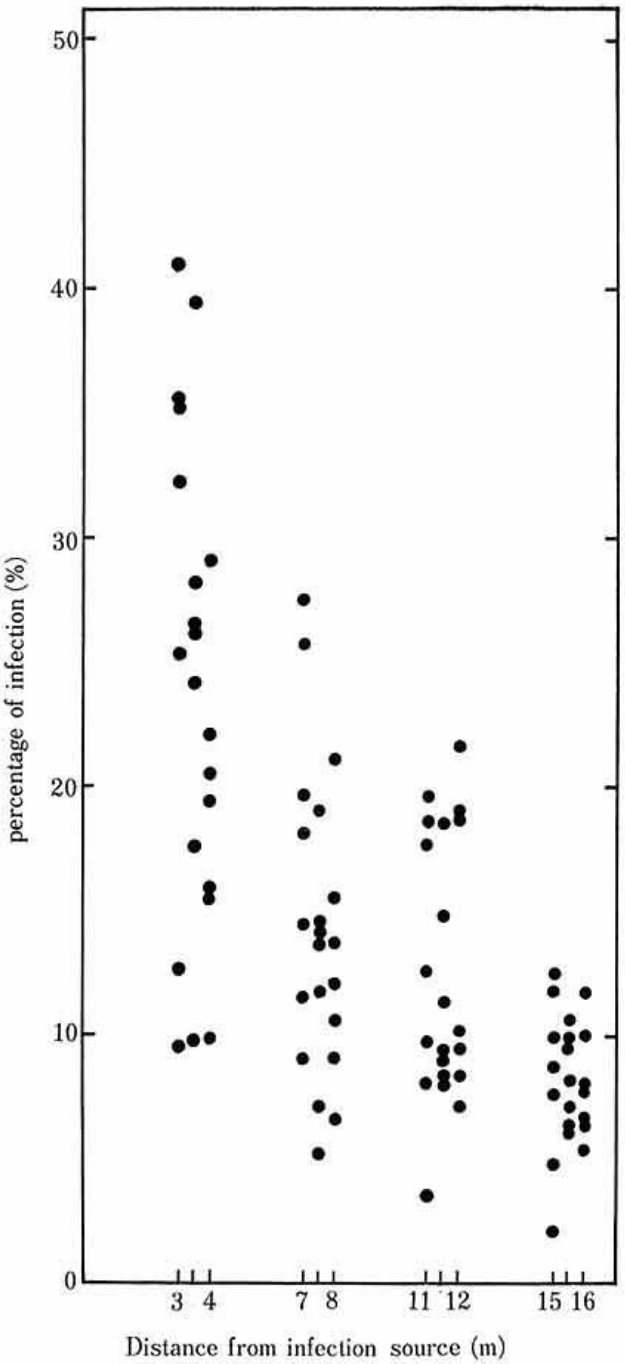

Fig. 1. Relationship between disease infection and distance from infection source

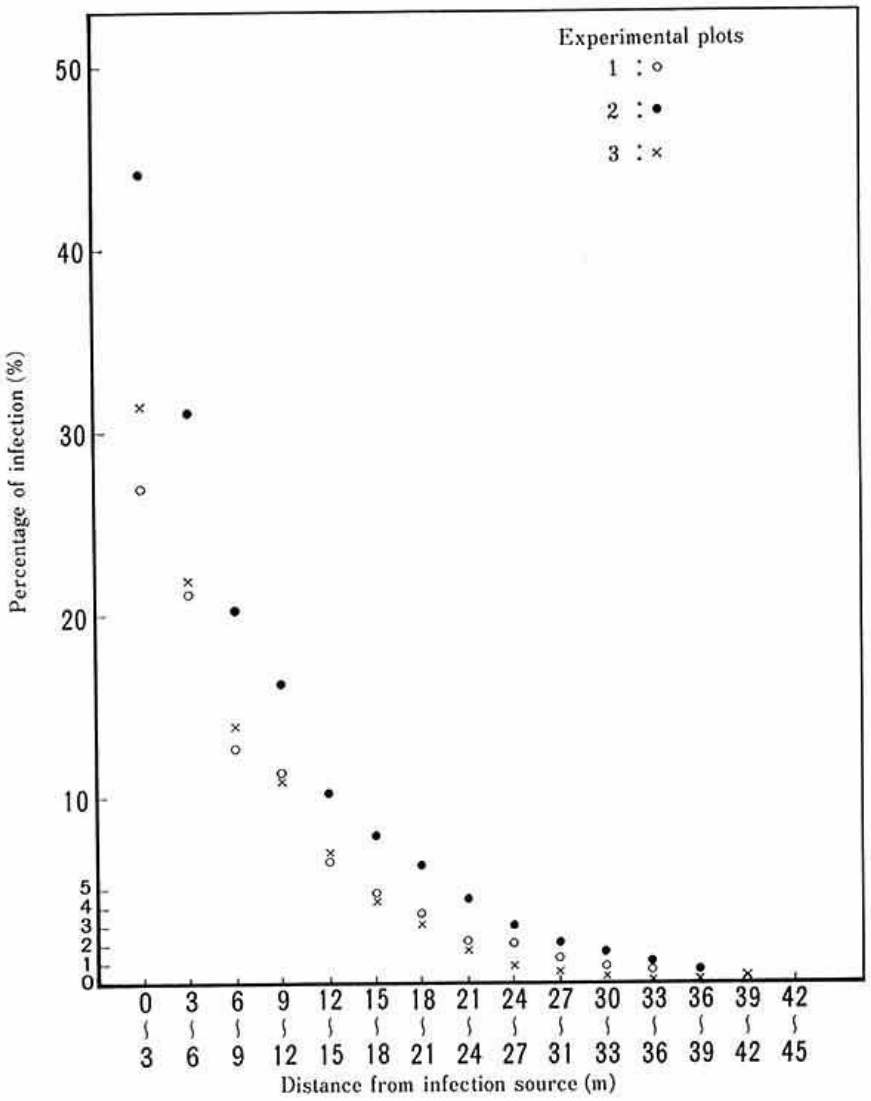

Fig. 2. Relationship between disease infection and distance from infection source

and average wind velocity: 1.58m/sec.

As shown in Fig. 1, the infection rate observed on rows near to the infection source was 9.4–40.9% showing rather wide variations, while the infection rate and its variations were decreased with the distance from the infection source. In the row 16 m away from the infection source, the rate was only 5.3–11.6%.

Average rate of infection as related to distances from the infection source was 30.2% at 3 m, 19.7% at 4 m, 17.3% at 7 m, and 7.8% at 16 m. The result indicates that the range of infection caused by the dispersed conidia is rather limited.

Then, the second experiment was carried out in a broader field to confirm the distance limitation for the infection.

An area with a diameter of 600 m, in which no maize plant exists, was selected. At the center of a 1 ha field in this area, 3 maize plants infected by *Sclerospora maydis* were transplanted in March and May 1973, and the conidia produced on these plants were used as the infection source.

Harapan, a susceptible variety was planted to the field with a spacing of 50 cm×50 cm and 1 plant/hill.

The experiment was repeated three times at different seasons in different fields.

The weather during the period of this experiment was adequate for the disease occurrence as in case of the first experiment, i.e., maximum, minimum and average temperature: around 30°C, 21–22°C and 25–26°C, respectively, air humidity: 70–80% (daytime) and

around 95% (night time), wind velocity: 1.0–1.5 m/sec.

Systemic symptoms began to appear 17–18 days after seeding, and reached the peak about one month after seeding. Every diseased plant recognized was removed and the distance from the infection source was measured each time. No newly developed symptom was recognized after the 54th day.

Fig. 2 shows a clear relationship between the infection rate and the distance from the infection source. The infection rate decreases with the distance away from the infection source. At a distance of 16 m, the rate was 5–8% which was nearly the same as recognized in the first experiment. No infected plant was found at a distance of 39–42 m. Thus it can be concluded that the range of infection caused by the dispersion of the conidia is limited to about 42 m from the infection source, as far as the present experiment is concerned.

Field surveys on the disease occurrence were made from the end of 1972 to 1973 in East Java, and severe outbreak was found in 5 fields at different locations. A common feature of these fields was that they were bordered by adjacent fields where maize was sown one month ago and diseased plants were detected as possible infection sources. In other fields without such infection sources, the infection rate was only 5–6%, except one case with nearly less than 20%. In an experiment not shown here, the authors recognized that the secondary infectoin due to the dispersion of the conidia hardly occurs among plants of the same leaf age (sown at the same time). It means that in fields where maize is sown at the same time and the leaf age of plants is uniform the secondary infection caused by the conidia may be extremely rare.

On the contrary, when there is a maize field within a distance of about 42 m, where seeding was made more than one month ago and infected plants exist, the newly planted maize suffers seriously from the secondary infection, resulting in the severe outbreak of the disease. This was always ascertained in all the fields surveyed.

According to Matsumoto et al. (1964)[1], the germination of the conidia requires air humidity of 100%. The authors[3,4] observed large diurnal fluctuations of air humidity in Indonesia and Taiwan. Air humidity increases after sunset, used to reaching higher than 90% by 8:00 p.m., and is maintained until early morning (6:00 a.m.). After sunrise, it decreases and is kept around 60–70% during the daytime. Therefore, the infection takes place only when the conidia, dispersed at about 2:00–4:00 a.m., germinates and conidial germtubes enter into leaf tissues before sunrise. The conidia remained without germination losses the pathogenicity.

In Indonesia, the wind velocity is very low, particularly at night. Under such condition, the dispersion of the conidia is limited within a short distance: about 42 m in this case.

Based on these experimental results and field survey observations, it is recommended that to prevent the severe outbreak of the downy mildew disease the source of the secondary infection, i.e., diseased plants producing the conidia, should be eliminated from neighboring maize fields before the seeding of maize, because the cause of severe outbreaks is the secondary infection from adjacent maize fields. This method of control may be useful also in other tropical countries with similar climatic conditions.

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Haruo MIKOSHIBA *Tropical Agriculture Research Center, Japan.*
Mas SUDJADI *Central Research Institute for Agriculture, Indonesia.*
Ahamad SOADIARTO *Central Research Institute for Agriculture, Indonesia.*