

SPORE RELEASE AND DISPERSAL IN GINGER LEAF SPOT PATHOGEN—*PHYLLOSTICTIA ZINGIBERI*

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ABSTRACT

Spore release from the pycnidium depends upon its contact with water drops. Pycnidiospores were released in the form of cirrus through ostioles. Rain splash has a vital role in the dispersal of spores. Multidirectional traps were used for collecting spores carried by rain splash. Though pycnidiospores could be trapped at distances upto 120cm horizontally and upto 75cm vertically from the infection foci, the number of spores caught was higher at closer distance. Spores could also be collected from the dew-drops during morning hours. The importance of this phenomenon in disease incidence is discussed.

INTRODUCTION

Ejection of conidia occurs in various *Phyllosticta* spp. in an abundant gelatinous mass if sufficient moisture is supplied (Bilgrami, 1963) and this accounts for the spread of leaf spot disease in different plant species during July–August. The pathogen, *Phyllosticta zingiberi* Ramakr., causal agent of leaf spot of ginger, produces pycnidia on the lesions under wet conditions. The disease is generally noticed in the field during the South-West monsoon period and thereafter. However, no information is available on the spore release pattern and spore dispersal *vis-a-vis* disease incidence. Hence, to bridge the gap on these aspects, studies were initiated.

MATERIAL AND METHODS

To study the role of high humidity in spore release, 20 pycnidia were spread over a clean microscope slide and incubated at 90, 95 and 100% relative humidity. To another set, drops of water were added. Release of pycnidiospores was monitored periodically.

Multidirectional spore traps were used for collecting splashed spores. The traps were placed in the field at horizontal distances of 30, 60, 90, 120 and 150 cm and at different heights of 30, 60, 75 and 90 cm from the infected plants. The volume of water collected in the tube was reduced to 5 ml by evaporating under a ceiling fan. Spore content per ml of water was calculated with the help of haemocytometer. Dew drops were also collected during non-rainy days and presence of spores examined under a microscope.

The observations on disease intensities were recorded in the ginger field at the Institute farm from July to November at monthly intervals for 3 years, 1978, 1979 and 1980. Observations were recorded on 100 randomly selected seedlings. The scale of rating comprising 6 grades was prepared on the basis of number of spots. The disease intensity was calculated according to the formula developed by McKinney (1923).

The meteorological data recorded at the Institute were used for correlating with disease intensity.

To study the spore load, the lesion size was measured and the lesions were grouped into 6 categories (≤ 2.5 mm², 2.5–5 mm², 5.0–7.5 mm², 7.5–10.0 mm², 10.0–12.5 mm², and 12.5 mm² and above). Number of pycnidia coming under different categories was recorded and number of spores computed.

RESULTS AND DISCUSSION

No spores were released at any of the different humidity levels tried, but when the pycnidia came in direct contact with water drops, spore release occurred. Spores oozed out of the pycnidium through the ostiole in the form of a cirrus. Dew drops collected in the morning hours contained a good number of mostly germinating spores. It is apparent that rain drop or dew alone and not merely humidity, can bring about spore release. For subsequent dispersal it has to depend upon splash mechanism. Gruenhagen (1945) observed a similar situation in *Hypoxylon pruinaum*, a causal agent of poplar canker, where a humid atmosphere alone did not influence discharge, but only wetting of stroma was effec-

tive. In *Mycosphaerella pyroides*, causing foot rot of peas, perithecia are formed on pea straw. The spore liberation in this pathogen depended on wetting, and this could be provided by dew alone (Carter, 1963).

Spore dispersal occurred efficiently when there was rain splash. Pycnidiospores trapped at different distances and heights from the focus of infection under different amounts of rainfall are shown in Tables 1 and 2. It was observed that the extent of dispersal,

Table 1. Horizontal splash dispersal of pycnidiospores

Date of observation	Rainfall (mm)	Distance (cm)	Spores trapped ('000/ml)
1-10-1980	6.4	30	20
		60	20
		90	10
		120	—
		150	—
2-10-1980	24.3	30	100
		60	50
		90	30
		120	10
		150	—
3-10-1980	15.2	30	80
		60	60
		90	30
		120	10
		150	—
11-10-1980	42.8	30	90
		60	60
		90	30
		120	20
		150	—
13-10-1980	5.2	30	20
		60	10
		90	—
		120	—
		150	—
23-10-1980	26.4	30	60
		60	30
		90	20
		120	10
		150	—

Table 2. Vertical splash dispersal of pycnidiospores

Date of observation	Rainfall (mm)	Height (cm)	No. of Spores trapped (000/ml)
25-10-1980	8.3	30	20
		60	10
		75	—
		90	—
17-11-1980	19.8	30	30
		60	20
		75	10
		90	—
19-11-1980	11.3	30	20
		60	10
		75	—
		90	—
20-11-1980	5.5	30	20
		60	10
		75	—
		90	—
21-11-1980	12.4	30	20
		60	20
		75	—
		90	—

either horizontally or vertically, was dependent upon intensity of precipitation. Spore catch was higher at proximal points from the source and again was dependent upon intensity of precipitation. Higher intensity of rain accompanied by wind seems to exert greater impact on target leaf, so that rain drops are splashed to greater distances resulting in liberation of greater amounts of spores. Studying rain dispersal of uredospores of coffee rust, *Hemileia vastatrix*, Bock (1962) observed that abundant number of spores were deposited, that too only after heavy showers when daily rainfall exceeded 0.8 cm. In *Valsa leucostoma*, conidia were shown to be dispersed by wind-blown rain, and the distance of dispersal was correlated with the mean wind velocity during rain (Bertrand and English, 1976). Singh and Renfro (1971) could trap spores of *Sclerophthora rayssiae* var. *zeae*, horizontally upto 1.65m, and vertically upto 0.90m.

The number of pycnidia per lesion increased with increase in size of the lesion, and so also the number of spores (Table 3).

Table 3. Number of Pycnidia under different lesion sizes

Lesion area (mm ²)	No. of pycnidia	No. of Pycnidiospores (10 ⁵)
≤ 2.50	8.10	6.50
2.50— 5.00	9.93	8.00
5.00— 7.50	11.73	9.70
7.50—10.00	12.39	10.25
10.00—12.50	15.63	13.00
12.50 and above	17.04	14.10

The data on relationship between climatic factors, mainly humidity, temperature and rainfall, and disease incidence are presented in Table 4. The disease appeared in traces only towards the end of June, though the plants were at the most susceptible stage (3–4 leaf stage) and received high cumulative rainfall (1003.13 mm) for disease spread. During the first fortnight of the month, build up of inoculum was not sufficient with comparatively drier conditions when temperature varied between 23.4–29.6°C, and relative humidity was between 83.3–90.1%. This would have resulted in a lower level of disease incidence. Mandokhot and Basu Chowdhury (1980) found that the age of the crop, rainfall, humidity and temperature were important factors in the disease development of *Curvularia* leaf-spot of maize.

Table 4. Mean temperature, relative humidity, rainfall, and number of rainy days *vis-a-vis* leaf-spot disease incidence*

Months	Temperature °C		Humidity (%)		Rainfall (mm)	No. of Rainy days	% Disease incidence
	Max.	Min.	Forenoon	Afternoon			
June	29.6	23.4	90.1	83.3	1003.14	27.0	Traces
July	28.5	22.9	95.6	85.1	1084.30	29.9	10.05
August	28.5	23.1	94.3	84.3	763.20	28.3	19.00
September	29.2	22.6	93.0	77.0	239.00	17.3	22.55
October	31.3	23.2	95.0	70.3	99.10	10.3	21.72
November	31.9	22.1	91.3	64.0	115.15	9.0	18.99

*mean of three years

July received the highest mean rainfall (1084.3mm) and had a mean 29.9 rainy days. This was accompanied by high humidity (85.0–95.6%) and lower temperatures (23.90–28.85°C) with a corresponding disease incidence of 10.05%. The temperature range of 23.0–28.0°C is found to be very favourable for the development of this disease (Brahma, unpublished). Very favourable weather conditions prevailed throughout August also, which encouraged further disease spread, and the disease incidence reached 19.10%. With intermittent rainfall and favourable temperature, disease incidence gradually increased in September to 22.55%. The severity of glume blight disease of rice caused by *Phyllosticta glumarum* (E11. & Tr.) Miyake, was reported to be associated with heavy but intermittent precipitation four weeks prior to flowering (Singh *et al.*, 1978).

During October, the total rainfall was considerably reduced (99.10mm), so also the number of rainy days (10.3 days). The temperature also was higher (23.2–31.3°C), and as such there was no further fresh incidence. In fact, disease decreased gradually in October and November to 18.99%. The new leaves which were emerging in fewer numbers during this period were not affected by the disease because of uncongenial conditions. von Ramm and Lucas (1963) observed that a few rains in July helped in the development of a very low percentage of tobacco brown spot. A heavy rain at the beginning, and subsequent wet conditions throughout August helped in rapid disease development.

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DISCUSSION

- C. RAJENDRAN (C.C.R.I.): What is the incubation period of *Phyllosticta zingiberi* on ginger?
- R. N. BRAHMA: 48 hours.
- A. H. RAJASAB (Gulbarga Univ.): Shri Brahma has used the drum-trap to study the horizontal dispersal of the pathogen. Instead, the susceptible host itself can be used for trapping spores. Similar observations are also reported by Hirst.