STUDIES ON COFFEE LEAF RUST IN EAST JAVA [1])

With Indonesian Summary

PENELITIAN PENJAKIT KARAT DAUN KOPI DI DJAWA TIMUR

by

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RINGKASAN

Uredospora Hemileia vastatrix, penjebab penjakit karat daun kopi, tumbuh lebih baik didalam air dan dalam keadaan gelap. Di Djampit (Djawa Timur) 7 — 10 djam sesudah inokulasi tjendawan mengadakan penetrasi kedalam daun kopi, melalui mulut kulit pada sisi bawah. Masa inkubasi adalah 16 – 27 hari dan pembentukan spora terdjadi 25 – 34 hari sesudah penetrasi. Angin tidak memegang peranan penting pada penjebaran spora. Pada tahun 1964, epidemi berkembang dengan lambat dari April sampai Djuni. Pada bulan Djuli, setelah kurang lebih tiga generasi dari tjendawan penjebab penjakit, epidemi berkembang dengan tjepat.

Air jang memertjik dari permukaan jang mempunjai endapan fungisida, ternjata dapat membawa sedikit dari obat tersebut dan mempunjai pengaruh jang tjukup terhadap perketjambahan spora, meskipun pengaruhnja sedikit kurang djika dibandingkan dengan endapannja sendiri. Sangat diperlukan penelitian untuk memberantas penjakit karat daun kopi dengan penjemprotan dan penjerbukan fungisida.

SUMMARY

Uredospore of Hemileia vastatrix, grow better in water and in the absence of light. In Djampit (East Java) 7 - 10 hours after inoculation the fungus penetrated coffee leaves through stomata on the lower surface. Incubation period was 16 - 27 days and sporulation took place 25 - 34 days after penetration.

Wind played no important role in spore dispersal. In 1964 the epidemic progressed slowly from April to June. In July, after about three generations of the causel fungus, the epidemic increassed markedly. Water splashes carrying fungicide deposit had a considerable influence on spore germination alt hough the influence was a little lower than of the deposit itself. Field experiments to control leaf rust by spraying and dusting are desirable

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INTRODUCTION

The first appearance of coffee leaf rust Java and Sumatra was recorded in 1876 (5). The disease is caused by an Uredinales. Hemileia vastatrix B et Br. The fungus destroyed Coffee arabica L, he planted coffee species of that time and held up the progress of the coffee plantations in Java.

Attempts were made to maintain the coffee plantations here and most of the estates replaced the planted species by C. leberica Bull.But later the new species proved to be susceptible to leaf rust and at last in 1900 C. robusta was imported. The new species is highly resistant and till now it has had no trouble from leaf rust Robusta coffee was soon adopted by planters and was planted in most of the plantations. At the present time arabica coffee is only foud at high altirudes suchas on the Idjen Plateau (East-Java)

But unfortunately, in spite of its high resistance to leaf rust, the beans of robusta coffee have inferior quality. Therefore in recent years attempts have been made to enlarge arabica plantations again and plant this species at lower altitudes. This will be possible onlyi f we can control leaf rust efficiently

The first appearance of Hemileia in Indonesia happened before the development of fungicides 1), so we in Indonesia have no experience of controlling leaf rust by fungicides.

But in Kenya (East-Africa), where leaf rust was introduced in 1913, much effort has been made to control the disease by fungicides. It has been proved that the disease is controlled economically by application of copper fungicides several times a year (2,6)

If we in Indonesia want to extand arabica plantations to lower altitutes, chemical control is unavoidable. For this purpose we have to know the biology and epidemiology of the causal organism. So in 1964 investigation was carried out by the author in Djampit Estate, Idjen Plateau. The estate has an altitude of 1500 - 1800 meters with a daily temperature 9-25° C.

Properly we ought to have carried out the study in the area where the plantations are planned But unfortunately it is difficult to find arabica coffee grown at low altitudes.

EXPERIMENTS (METHODS AND RESULTS).

1. Influence of water and light on spore germination.

Mature uredospores were taken from mature pustules on the leaves of C. arabica var. Blawan-Pasumah in the field. The spores were dusted by camelhair brush into glass slides. Sterile aquadest was dropped on one half of the slides which were then incubated in glass boxes kept moist by wet cotton wool. Half of the boxes were put in completely dark room. The others were put in diffuse sun light during day time and illuminated constantly by electric lamps during the night. Examination was done microscopically after 24 hours.

1) Berdeaux mixture was discovered by MILLARDED in 1882.

Each object consisted of ten slides and the trial was replicated 7 times during the months April to September 1964.

The result of these trials is shown in table 1

Table 1. Influence of water and light on percentage of spore germination, after 24 hours incubation.

in water drop		in moist air	
light	dark	light	dark
14,8	64,3	4,7	6,1
12,4	49,6	5,2	7,2
5,0	53,2	2,9	5,7
6,0	58,2	3,9	5,6
4,8	51,7	2,0	6,9
24,3	81,9	1,6	8,5
33,2	71,8	1,6	1,8
14,4%	61,5%	3,1%	6,0%

2. INFLUENCE OF FUNGICIDES ON SPORE GERMINATION.

Fat-free glass slides were coated with gum arabic After drying the slides were dipped in fungicide suspension of measured concentration. In this trial Shell copper-fungicide (copperoxychloride 50% Cu wp) was used. When the fungicide had dried spore suspension was dropped on the slides and incubated.

In a dark moist chamber. After 24 hours the spores were examined with low power microscope. The result is shown in figure 1.

Since 1960, most of the research workers working on coffee leaf rust believe that Hemileia spores are mainly distributed by water, while wind plays only an insignificant role. They also believe that when a drop of water falls on the upper surfaee of the leaves, the water splashes transport spores to the lower surface of the leaves, where infections can take place. But if fungicide deposit is found on the upper surface, the splashes will also transport fungicide together with the spores (4).

To check this case the following trial was carried cud. Dry uredospores were put on the glass slides covered by gum arabic and deposit of Shell Copperfungicide suspension of measured concentration. The deposit had already dried when the spores were put on. Then water was dropped on the slides. The pipette was so located that the mouth was one meter above the slide. The splashes werc trapped by clean slides (fig. 2). The last montioned slides were then incubated in a dark and moist chamber. Microscopic examination was done after 24 hours. The result of the trial is shown in fig. 3.

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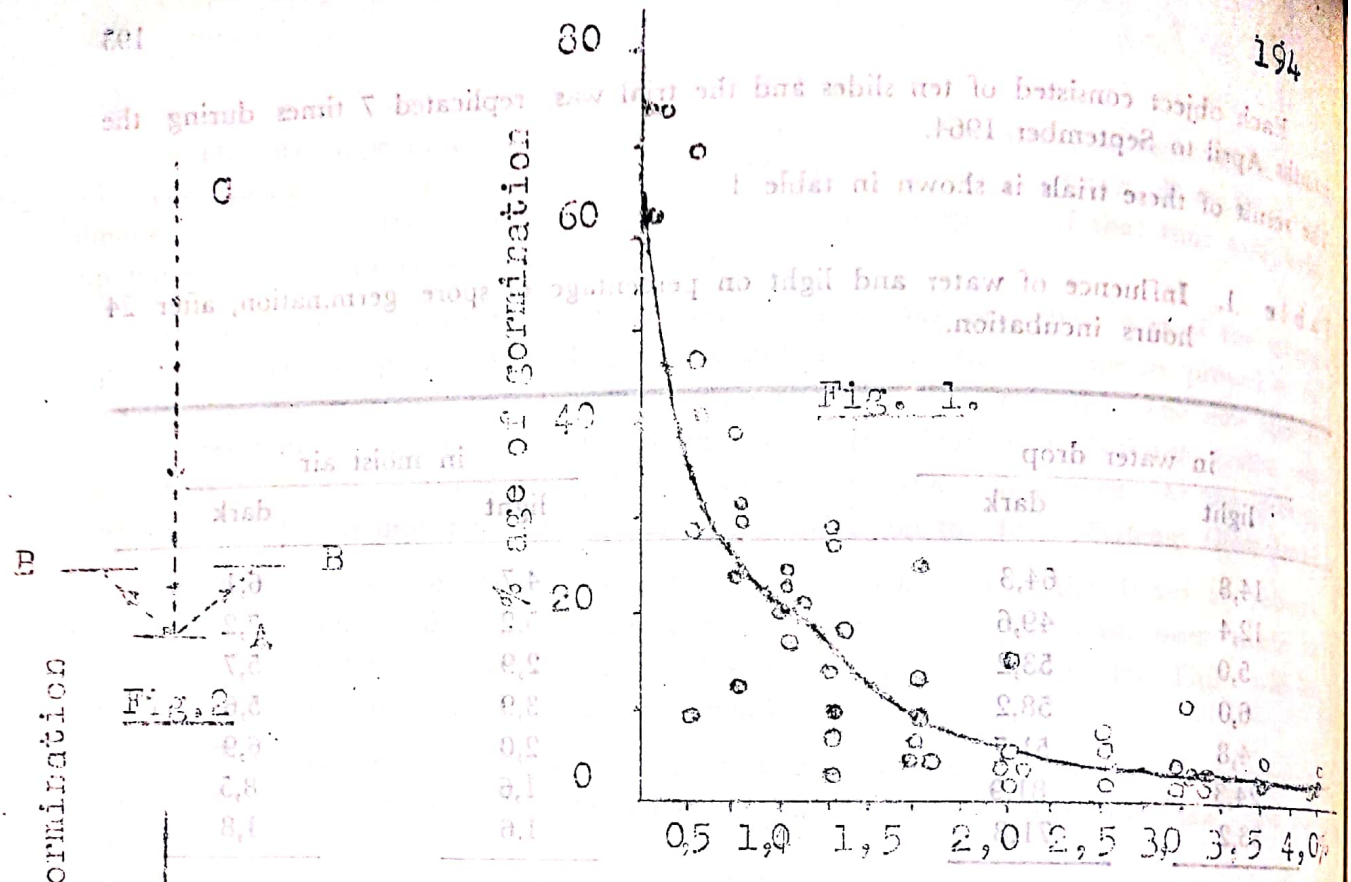

Fig. 1.

Fig. 2

Fig.1.

Influence of deposit of Snell Copperfungicide suspension on spore germination.

Fig.2.

Side view of the arrangement of the slides for trapping the splashes. A, slide covered by gum arabic, fungicide deposit and uredoapores. B, clean slides; C, water drop.

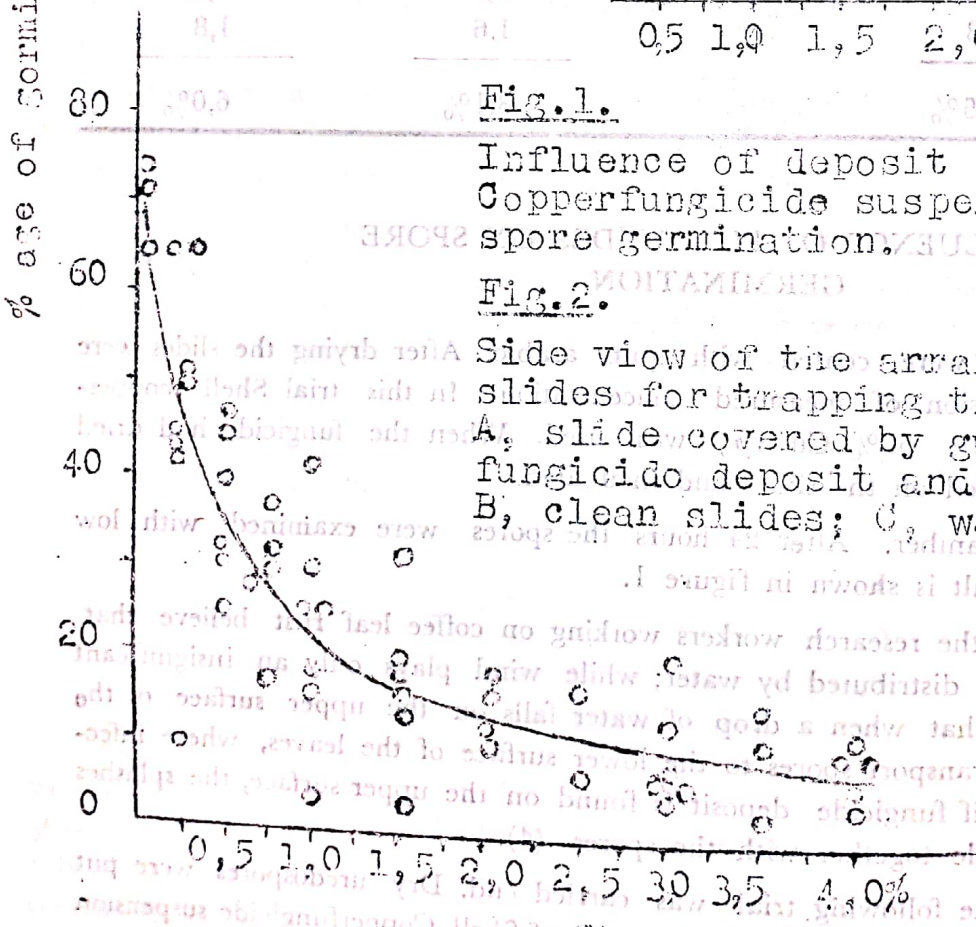

Fig.3.

Influence of Snell Copperfungicide carried by water splashes on the spore germination.
Abscissa: concestration of fungicide suspension giving deposit on the slide (slide A in fig.2).

Replacing the glass slides with coffee leaves gave almost the same result.

3. PENETRATION, INCUBATION PERIOD AND SPORULATION

To find out when penetration taken place, inoculations were carried out on the lower surface of detached third leaves (from the growing point), picked from Blawan Pasumah plants. After spore suspension had been dropped on to them, the leaves were incubated in glass boxes in the dark. The temperature noted was 17 – 18° C. Examinations were done every hours by making sections (table 2).

Table 2. DISTRIBUTION OF NUMBER OF PENETRATIONS AMONG 85 INCIDENCES OBSERVED

Hours after inoculation	5	6	7	8	9	10
Number of incidences	0	0	10	21	27	27

The author was unable to demonstrate any difference of resistence in leaves of different ages, although in one of the inoculation trials the older leaves seemed to be more susceptible.

Inoculation on the upper surface gives no result.

Inoculation period of leaf rust was variable. Inoculation experiments were carried out in a Blawan-Pasumah field, on twigs covered by plastic bags. This was done in April 1964 with daily temperature 13 – 25° C. Symptoms in the form of chlorotic spots were visible 16 – 17 days after inoculation, while spores were produced 25 – 34 days after inoculation. The distribution in shown in fig. 4.

In another trial carried out in July with temperature 11 – 23° C. spores were produced 40 – 46 days after inoculation.

4. DISTRIBUTION OF SPORES BY WIND.

To know whether rust spores are distributed by wind, petridishes were exposed at certain distances from the border of a diseased plot. After 24 hours microscopic spore countings were made. Four replications were carried out on clear days during the months July and August 1964. The recorded wind velocity on those days was approximately 2,0 – 2,5 meters / sec. The result of these observations are shown in table 3.

Table 3. RELATION BETWEEN NUMBER OF SPORES / CM² AND THE DISTANCE TO THE DISEASED PLOT.

Distance in meters		0	1	2	3	4	5	10	15	20
Average number of spores / cm²	I.	0,6	1,1	0,6	0,3	0,4	0,6	0,4	0,4	0,1
	II.	2,1	2,3	1,3	1,0	0,7	0,3	0,4	0,3	0,0
	III.	1,0	0,9	0,5	0,4	0,4	0,3	0,3	0,1	0,1
	IV.	1,4	0,9	0,4	0,7	0,7	0,4	0,2	0.3	0,0

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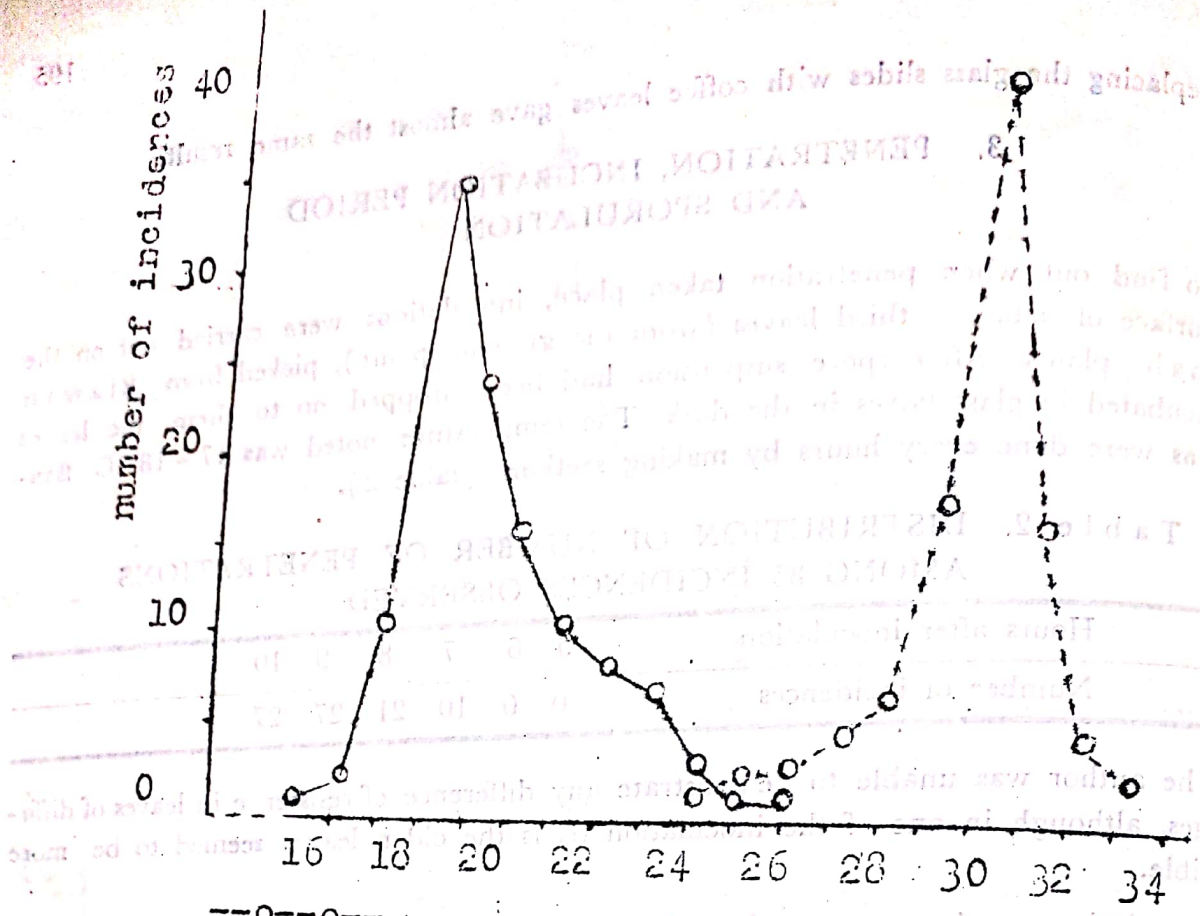

Fig. 4. Distribution of number of days needed for leaf rust to produce symptoms and spores.

5. RELATION OF EPIDEMIC TO RAINFALL.

At the beginning of the rainy season (Novamber), only a very few rusted leaves were found in Idjen Plateau. According to the labourers on the estate, the visible increase of the number of spots begins in March of April each year.

During the months April to September 1964, 100 leaves were picked periodically and the percentase of rusted leaves was noted. The picking was done at rendom on certain plot of the estate. Attempts were made to find out the relationship between rainfall and the intensity of rust. The result is plotted in fig. 5.

DISCUSSION

The results reported here in confirm the results of studies on coffee leaf rust in Kenya and India (4). The uredospores of Hemileia vastatrix grow better in a drop of water and in the absence of light. In the condition of Djampit Estate, penetration into the leaves could take place 7 hours after inoculation. Hence this can easily happen during a single night.

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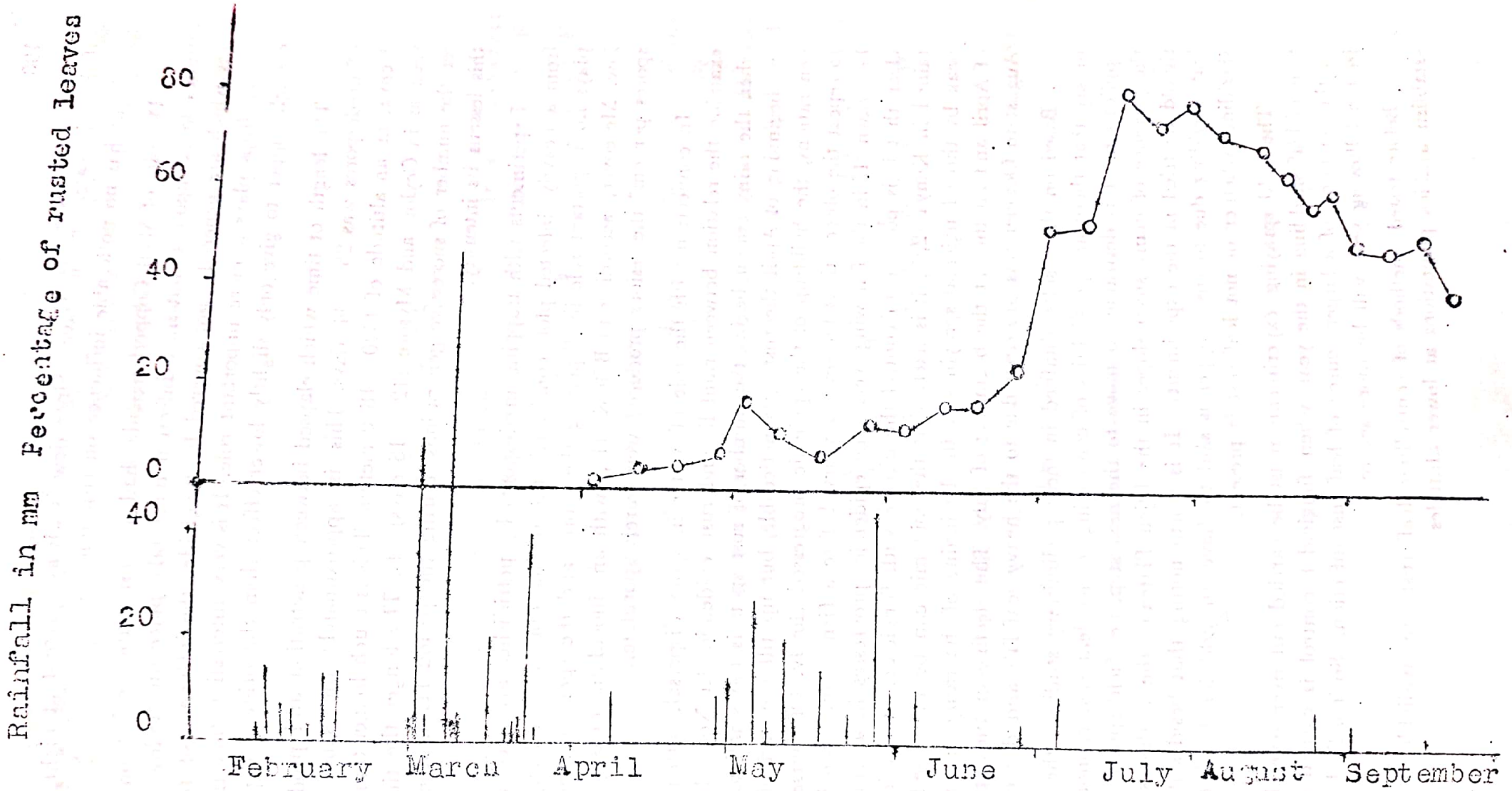

Fig.5. Relation between rainfall and percentage of rusted leaves.

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if there is water on the leaves. Since dew is always present at night, dry weather during day time has no noticeable influence on rust infection.

Deposits of Shell Copperfungicide had a considerable effect on the germination of spores found upon it. But since infection must take place on the lower surface on the leaves which are generally not covered by fungicide, the influence of fungicide brought by splash drops plays a more important role. It is very interesting that the splashes contained enough copper to give only slightly lower effect than the original deposit.

The length of time which elapsed between penetration and production of fresh crop of uredospores was 25 – 34 days. This is approximately the same as was the case in Kenya, at an altitude of 1500 – 1800 meters. This is much longer than in warmer climates such as in Ceylon and Mysore (12 – 16 days) (4). The longer the time needed, the smaller the number of successive generations during the period favourable to the disease and this lessens its intensity.

Experiments with trapping uredospores by petridishes arranged at different distances from a heavily infected plot confirmed the results obtained in Kenya (1,3). The wind plays no important role in dispersing the spores and the spore content of the air is very low. Moreover, according to BOCK (1), with an inoculum density of approximately 7 spores per cm^2 the lesions produced were rarely sporulate.

In connection with the role of water in spore dispersal, attempts were made to examine the relation between rainfall and rust epidemic. In November and December, when the rainy season begins, the number of rust spots is too small to be detected. After the beginning of April the rust was noticeable, but up till the and of June, about three generations, the build-up of the epidemic progressed slowly. Of course it will be necessary to repeat the observations for several years before a firm conclusion in epidemiology can be drawn. If in the following years the epidemic progresses in a similar way, it will be clear that it is possible to control the disease with fungicide. Considering the results obtained in Kenya (2,6), it is likely that the epidemic can be prevented from coming to a peak by three fungicidal sprayings at the beginning of the rainy season, at the beginning of April and another at the beginning of July. The decline of the attack in the months August to October was probably due to the heavy leaf fall and dry conditions.

Based on the results obtained in these preliminary studies, the author has reason to say that there are possibilities of controlling coffee leaf rust economically by fungicide application. It is desirable to move to the next step, i.e. field spraying experiments. With the presence of many steep slopes in the Idjen Plateau, the author suggests that dusting should be tried in the experiments. It is worth noting that besides its effect in reducing leaf shedding due to rust, copper is said to have an additional effect in posponing leaf shedding, whether or not leaf rust is present.

The field spraying experiments must be carried out over several years. The prevention of leaf shedding in the year when fungicidal control is carried out actually results in the retention of a larger source of leaf rust infection. So it is likely that the rust attack in the following year will be more severe.

Before tested methods of controlling leaf rust are available, it is not advisable to establish arabica plantations at lower altitudes.

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