Effects of Pyracarbolid on Coffee Leaf Rust in Kenya

S. K. Mulinge, Celia J. Baker, and J. L. Pereira

Senior Plant Pathologist, Plant Pathologist, and Senior Field Officer, respectively, at the Coffee Research Station, P.O. Box 4, Ruiru, Kenya.

Appreciation is expressed to Ellis Griffiths for many helpful suggestions during the preparation of the manuscript, to Mr. M. O. Aywa for technical assistance, and to Farbwerke Hoechst A. G., Frankfurt, W. Germany, for their close cooperation in this project.

Published with approval of the Director of Research of the Coffee Research Station.

ABSTRACT

The effects of pyracarbolid on coffee leaf rust (*Hemileia vastatrix* were studied in the field during an epidemic of the disease in the period July - November 1972, during which an oil-based formulation of the fungicide was applied at a rate of 0.6% product at three weekly intervals. Evidence was obtained which suggests that pyracarbolid accelerates abscission of already infected leaves and prevents the occurrence of new infections. On trees sprayed with pyracarbolid, abnormal and "pitted" leaf rust lesions developed from infections which occurred before spraying commenced. Lesions on the remaining treatments were normal.

Phytopathology 64:147-149

Additional key words: Hemileia vastatrix, coffee.

Fungicidal control of leaf rust (*Hemileia vastatrix* Berk. et Br.) in Kenya has for several decades been achieved by use of 50% copper fungicides (cuprous oxide or copper oxychloride) sprayed immediately before and just after the onset of the two rainy seasons (2, 3, 4). Although extensive screening of new fungicides has been conducted for a number of years, until the present none of the tested products has appeared superior to copper. Indications of the effectiveness of the fungicide pyracarbolid, as wettable powder formulations were obtained in field trials carried out at the Coffee Research Station, Ruiru, during 1971 and 1972 (1). In view of promising results obtained under extreme disease conditions, it was decided to spray at mid-epidemic to investigate the effect of the fungicide on the host and on disease development.

The field experiment was carried out in a low altitude leaf rust area of Kenya, Oaklands Estate, Ruiru (altitude 1,585 m) on a plot of *Coffea arabica* L. (cultivar 'SL 28') where, at the time of commencement of the trial, 90% of the leaves were infected with *H. vastatrix*. A randomized complete block design with four treatments, each applied to four replicated plots of 16 trees, was employed.

All fungicides were applied in water at a rate of 750 liters/hectare (ha) using Fontan R9 knapsack mistblowers, each tree receiving approximately 560 ml. The treatments: pyracarbolid 0.6%, carbendazim 0.4%, and cuprous oxide (Perenox) 0.7% were sprayed on 27 July, 16 August, 7 September, 6 October and 27 October and were compared with nonsprayed. All recordings were made during the period 27 July, 1972 - 15 November, 1972. The concns of pyracarbolid and carbendazim were selected from previous experiments as those giving optimum control. The standard rate of cuprous oxide recommended for leaf rust control in Kenya is 0.7%.

Detailed records of leaf rust progress on the existent and new leaves were carried out on branches marked randomly on the six central trees of each plot. Markers were attached behind the fifth node from the shoot apex bearing the fifth leaf pair (later referred to as nodes 1 to 5, nodes developing thereafter as nodes 6 to 10) and the number and size of the lesions developing, as well as loss and growth of new leaves, was recorded at 2-week intervals.

There were no significant differences in the numbers of infected leaves between nodes 1 and 5 or the total leaf population on the marked branches at the

commencement of the experiment. However, significant differences in the number of leaves showing infection occurred 3 weeks after spray application, a mean of 47.75 diseased leaves between nodes 1 to 5 being recorded for pyracarbolid, and 120.5, 123.5 and 119.5 for carbendazim, cuprous oxide and nonsprayed respectively [LSD (P = 0.05) = 30.11]. Differences of this order were maintained for the duration of the experiment.

The reduction in disease levels in the pyracarbolid treatment (Fig. 1) was primarily due to the defoliating action brought about by the fungicide and the effect was mainly on the diseased old leaves. During the period 31 July to 4 September a mean loss of 230.25 leaves was recorded between nodes 1 and 5 in the pyracarbolid treatment. Carbendazim-treated, cuprous oxide-treated, and nonsprayed trees lost 120, 144.75, and 115.25 respectively [LSD (P = 0.05) = 70.29]. After that time, the loss from the pyracarbolid treatment was significantly less (P = 0.01) than the losses from plants which received other treatments.

Irrespective of treatment during the experiment, approximately four new pairs of leaves emerged between nodes 6 and 10 on each branch and, although no significant changes occurred in the total population of the emerged leaves, a difference in number of diseased leaves was observed as the season progressed. All sprayed treatments were significantly less infected (P = 0.05), than the nonsprayed control by November. Thus, the defoliating effect of pyracarbolid observed between nodes 1 and 5 was not evident between nodes 6 and 10.

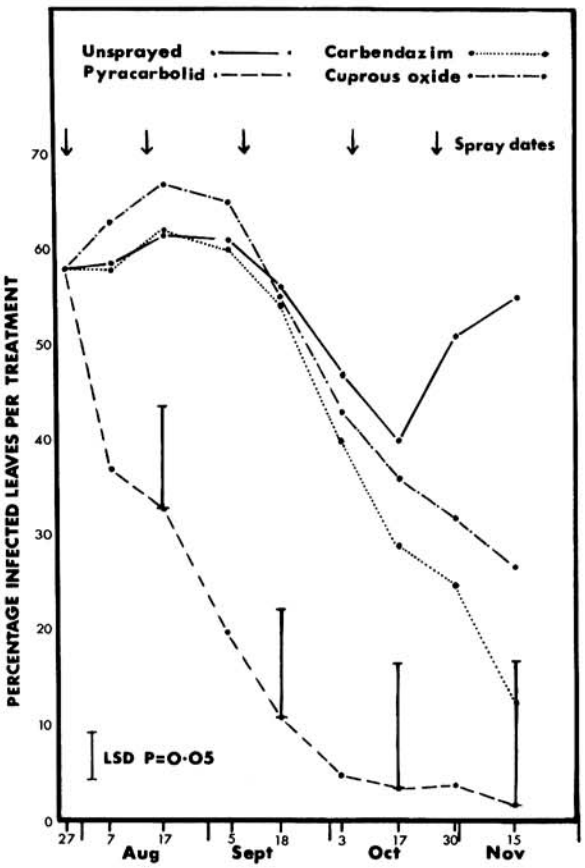

Fig. 1. Effects of selected fungicides on coffee leaf rust disease progress and development between nodes 1 and 5 of coffee plants in Kenya.

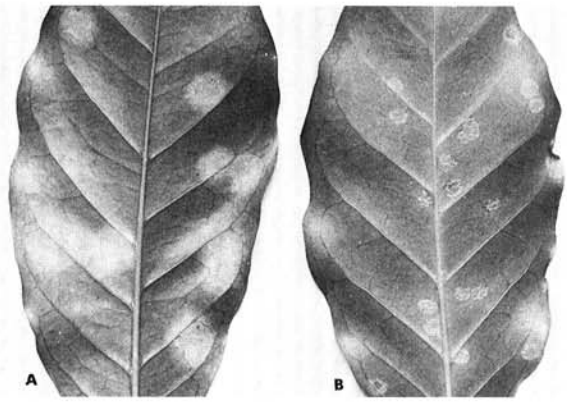

Fig. 2. Effect of pyracarbolid treatment on coffee leaf rust lesions. **A)** Nonsprayed leaf showing large and normal rust lesions. **B)** Leaf sprayed with pyracarbolid showing pitted lesions.

Unlike the other fungicides tested, pyracarbolid was observed to have some 'curative' effects which could have affected disease development and progress. By September, most lesions appearing on leaves sprayed with this product were restricted in size (Fig. 2), roughly circular and sunken, with pale brown 'pitted' margins. At the time the 'pitted' lesions were noticed it was difficult to obtain sufficient spores from them to compare the viability with spores from normal lesions. Lesions on plants receiving the other treatments appeared normal and sporulated freely.

A detailed study of lesion size on leaves 60 days after the commencement of spray was made. Many (71%) of the lesions occurring on leaves treated with pyracarbolid were no more than 4 mm in diam, whereas only 28% of the lesions on nonsprayed leaves fell into this category, 59% being in the range 4 mm - 12 mm. Very few lesions greater in diam than 12 mm (3%) were observed on pyracarbolid-sprayed leaves, while 13% of the lesions on nonsprayed leaves exceeded this size.

The superiority of pyracarbolid to both copper and carbendazim in preventing the progress and development of coffee leaf rust in this trial was evidently due both to its ability to selectively remove most of the diseased leaves and to its outstanding effect on restricting further growth of the lesions and the immediate reduction in the sporulating capacity of these lesions. These factors reduced the inoculum to the extent that further infection on the new leaves was largely prevented. The curative and abscissive action of pyracarbolid is in all probability due to its systemic properties, and the mechanism whereby diseased leaves are abscissed and new leaves are protected is a topic requiring further investigation. Additional studies on the effect of pyracarbolid on disease development are being made before the fungicide is recommended for general use in coffee in Kenya.

LITERATURE CITED

1. BAKER, C. J. 1973. 1972 Trials with new and recommended fungicides. Kenya Coff. 38(447):188-194.
2. BOCK, K. R. 1962. Control of coffee leaf rust in Kenya. Trans. Brit. Mycol. Soc. 45:301-313.
3. RAYNER, R. W. 1960. Rust disease of coffee. 4. Control by fungicide. World Crops, Aug: p. 309-312.
4. RAYNER, R. W. 1962. The control of rust in Kenya by fungicides. Ann. Appl. Biol. 50:245-261.