EFFECTIVENESS OF REDUCED RATES OF CUPROUS OXIDE AND CUPRIC HYDROXIDE IN CONTROLLING COFFEE LEAF RUST IN KENYA[1] /

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Resumen

Se encontró que la aplicación de 0.35 por ciento (3.8 kg/ha) óxido cuproso (Perenox y Copper Nordox) e hidróxido cúprico (Kocide 101) son eficientes en el control de la roya del café en tres sitios con alta infestación de roya durante los periodos 1979 y 1980.

Con la atomización con niveles bajos (0.35%) de Perenox, Copper Nordox y Kocide 101 se obtuvo rendimiento tan alto como los obtenidos al aplicar los resultados al 0.7 por ciento. Por lo tanto, se recomienda aplicar 3.8 kg/ha de Perenox, Copper Nordox y Kocide 101 para el control de la roya del café en Kenia.

Introduction

Coffee Leaf Rust caused by the fungus *Hemileia vastatrix* Berk. et. Br. is the most serious leaf disease of coffee particularly in low and medium altitude districts of Kenya. Although berries are not directly affected and trees are rarely killed, the main damage can result from premature leaf-fall which may reduce future yields.

Copper based fungicides and various organic fungicides are currently used to control leaf rust (2). The anti-rust sprays are applied immediately before and just after the onset of the two rainy seasons in Kenya (3, 6). In field trials a 50 percent formulation of cuprous oxide (Copper Sandoz MZ) was found effective against leaf rust at 0.35 percent (3.8 kg/ha) compared with the previously recommended full rate of 0.7 percent (5). Therefore, the reduced rate of 0.35 percent of Copper Sandoz MZ was recommended to the growers in 1977 to control leaf rust (1). It was not known whether or not lower application rates of other cuprous oxide formulations (Perenox and Copper Nordox) and cupric hydroxide (Kocide 101) containing 50 percent copper would also control leaf rust effectively. In view of this, trials were carried out during 1978/79 to investigate whether or not the application rates of 0.35 percent, 0.4 percent and 0.5 percent of Perenox, Copper Nordox and Kocide 101 could control leaf rust as effectively as the full rate of 0.7 percent of the same product.

Perenox 50 percent WP 0.7 percent and Copper Sandoz MZ 50 percent WP 0.35 percent were included in these trials as standard treatments. The trials were repeated during the 1979/80 period.

Materials and methods

Experimental design

The trials were laid down on the standard randomized complete block design with 14 treatments replicated four times. Individual plot consisted of twenty five trees (5 x 5). An unsprayed plot served as a control.

Sites

The trials were carried out on three different Estates namely, Jacaranda Estate (CRS plot 14 Trial I), Thika River Estate (Thika River Trial I) and Azania Estate (Azania Trial I).

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Jacaranda Estate is situated at an altitude of 1 608 m on the Eastern slopes of Aberdare range (1.06° South, 36.4° East of Greenwick). Thika River Estate is situated at an altitude of 1 496 m on the Eastern slopes of Aberdare range (1.0° South, 37.0° East of Greenwick) Azania Estate is situated at an altitude of 1 464 m on the Eastern slopes of Aberdare range (1.05° South, 37 0° East of Greenwick).

The annual rainfall for all aforementioned three sites is bimodally distributed, with the main rainy seasons being March – May (Long Rains) and November – December (Short Rains).

The experimental area was the same in both years at each site. All coffee trees were without shade. The spacing of the coffee at three sites was 2 74 m x 2.74 m.

Cultivar

At Jacaranda Estate planting consisted of the cultivar SL – 34, at Azania Estate the trees were of cultivar SL 28 and at Thika River Estate the trees were of Cultivar SL – 34. Both SL – 34 and SL – 28 are very susceptible to leaf rust infection.

Leaf rust recording

Records of leaf rust infection were made at 4 – week intervals throughout the experimental period. Leaf Rust recording was achieved by taking 70 leaves randomly selected from each 9 central trees per plot. The total number of leaves infected in relation to the total number of leaves picked, was used to calculate the percent leaf rust infection (7).

Statistical analysis

A standard analysis of variance was computed for each recording and for analysis actual mean percentages (infection) were converted to transformed percentages (Arcsin $\sqrt{\%}$) but in figures actual mean percentages were used

Yield recording

Ripe cherries were harvested at 10 – day intervals from all 25 trees per plot and yield recorded at each harvest as fresh weight of cherry and were converted to yield of clean coffee in kg/ha based on 1 330 trees per hectare and assuming that cherry yields on seventh of its weight as clean coffee (4).

Spraying equipment

The fungicides were applied with motorised knapsack sprayers at the rate of 80 litres per 100 trees (approximately 800 ml per tree).

On each site, to control coffee berry disease (CBD) the whole experimental area was blanket sprayed with 4.4 kg/ha of Daconil 75 percent WP following the CBD control programme which was recommended for the period under review for the control of CBD.

The spraying dates at three sites the fungicides used and their rates of application are summarized in Table 1.

Results

CRS Plot 14 Trial I (Jacaranda Estate)

The leaf rust epidemic at Jacaranda Estate during 1978/79 was moderately severe. The peak of the rust epidemic occurred in August 1979 when the percent leaf rust infection was 45 percent (41.98% transformed) in the control (unsprayed) plots. The reduced rates of Perenox (0.35%), Copper Nordox (0.35%) and Kocide 101 (0.35%) controlled leaf rust as effectively as the full rate of 0 7% of the same product. There was no statistical difference (P = 0.05).

In the following year 1979/80, the leaf rust epidemic was low and the peak of the rust epidemic occurred in September 1980 when the percent rust infection was 8.49 percent (17.57% transformed) in the control plots. The levels of leaf rust infection were not high enough in the control plots to draw any conclusion from data obtained in 1979/80. The results are summarized in Table 2.

Effect on yield: During 1978/79 in CRS plot 14 Trial I, plots treated with reduced rates of Perenox (0.35%), Copper Nordox (0.35%) and Kocide 101 (0.35%) gave yields lower than the standard treatment Perenox (0.7%) but the difference in yield was not significant statistically (at P = 0.05).

During 1979/80, plots treated with Perenox, (0 35%) and Copper Nordox (0.35%) gave yields as high as the standard treatment Perenox (0.7%) but plots sprayed with Kocide 101 (0.35%) and Copper Sandoz (0.35%) had yields significantly (at P = 0.05) lower than the standard treatment Perenox (0 7%). The results are shown in Table 3.

Thika River Trial II (Thika River Estate)

The leaf rust epidemic at Thika River Estate during the 1978/79 period was considered severe. The peak of the rust epidemic occurred in July 1979, when the percent leaf rust infection was 68.46 percent (55.95% transformed) in the control (unsprayed) plots. There was a significant (at P = 0.05) reduction in the incidence of leaf rust on plots sprayed with

Table 1. Date and rate of application of Perenox, Copper Nordox and Kocide 101 on various sites.

Treatments	% rate of application	Active ingredients	Spraying Dates: Jacaranda Estate (CRS Plot 14 Trial I)	Azania Estate (Azania Estate Trial I)	Thika River Estate (Thika River Estate Trial I)
			(1978/79)	(1978/79)	(1978/79)
Perenox 50% WP	0 70	Cuprous oxide	October 28, Nov.	October 19,	October 18,
Perenox 50% WP	0 50	Cuprous oxide	18, 1978, Feb. 20,	Nov. 9, 1978;	November 8, 1978;
Perenox 50% WP	0 40	Cuprous oxide	March 13, April 25,	Feb. 15, March 6,	Feb. 27, March 23,
Perenox 50% WP	0 35	Cuprous oxide	May 17, 1979	April 21, May	April 12, May 6,
Copper Nordox 50% WP	0 70	Cuprous oxide		12, 1979	1979
Copper Nordox 50% WP	0 50	Cuprous oxide			
Copper Nordox 50% WP	0 40	Cuprous oxide	(1979/80)	(1979/80)	(1979/80)
Copper Nordox 50% WP	0 35	Cuprous oxide			
Kocide 101 50% WP	0 70	Cupric hydroxide	October 16,	October 18, Nov	October 23,
Kocide 101 50% WP	0 50	Cupric hydroxide	November 6, 1979;	9, 1979; Feb. 16,	November 11, 1979;
Kocide 101 50% WP	0 40	Cupric hydroxide	February 11, March 3,	March 7, April 3,	February 20,
Kocide 101 50% WP	0 35	Cupric hydroxide	March 28, May 18,	May 18, 1980	March 12,
Copper Sandoz MZ 50% WP	0 35	Cuprous oxide	1980		April 10,
					May 2, 1980

Table 2. Percent (Arcsin $\sqrt{\%}$) leaf rust infection at Jacaranda Estate (CRS Plot 14 Trial I) on plots spraved with reduced rates of application of Perenox, Copper Nordox and Kocide 101 during 1979–80.

Treatments	% rate of application	Analysis of % (Arcsin $\sqrt{\%}$) Leaf Rust infection on: 1979				1980			
		2.7.79	24.7.79	15.8.79	6.9.79	21.7.80	12.8.80	1.9.80	22.9.80
Perenox 50% WP	0 70	4 9	3 0	2 0	5 5	3 9	5 5	5 8	4 2
Perenox 50% WP	0 50	6 7	3 8	5 0	7 9	7 5	9 8	9 8	8 7
Perenox 50% WP	0 40	7 9	5 0	5 2	7 3	6 8	10 5	11 2	8 5
Perenox 50% WP	0 35	6 5	6 5	7 0	7 9	9 3	10 0	10 9	9 6
Copper Nordox 50% WP	0 70	5 9	6 2	4 5	7 5	5 4	6 5	7 0	3 7
Copper Nordox 50% WP	0 50	5 8	5 6	3 3	6 1	6 8	6 8	8 0	6 8
Copper Nordox 50% WP	0 40	6 4	5 3	6 4	7 1	7 2	9 1	10 5	7 3
Copper Nordox 50% WP	0 35	7 1	6 7	6 4	8 3	8 6	10 3	10 9	7 1
Kocide 101 50% WP	0 70	7 2	6 3	4 6	5 4	6 5	6 5	7 0	6 6
Kocide 101 50% WP	0 50	5 7	6 1	4 3	7 1	7 1	8 6	9 4	8 6
Kocide 101 50% WP	0 50	6 8	5 4	4 7	5 8	7 0	10 6	12 5	8 9
Kocide 101 50% WP	0 35	7 5	6 5	6 8	7 6	11 7	12 2	13 9	12 2
Copper Sandoz MZ 50% WP	0 35	5 6	6 8	5 2	7 1	9 2	11 4	11 9	7 8
Unsprayed (control)	–	23 7	34 1	41 9	37 6	13 1	16 7	17 5	13 2
LSD P = 0 05	–	4 0	4 4	5 9	4 5	2 9	3 1	3 5	3 1
CV	–	37 4%	41 1%	37 6 %	34 5%	26 2%	22 8%	23 3%	26 9%

Table 3. Yield and Peak % leaf rust infection in plots sprayed with reduced rates of application of Perenox, Copper Nordox and Kocide 101 in CRS Plot 14 Trial I.

Treatments	% rate of application	Peak % leaf rust infection (transformed) 15.8.79	Clean coffee yield kg/ha 1978/79	Peak % leaf rust infection (transformed) 1.9.80	Clean coffee yield kg/ha 1979/80
Perenox 50% WP	0.70	2.0	1 450.0	5.8	1 449.0
Perenox 50% WP	0.50	5.0	873.0	9.8	1 451.2
Perenox 50% WP	0.40	5.2	1 155.5	11.2	1 451.4
Perenox 50% WP	0.35	7.0	874.1	10.9	1 351.3
Copper Nordox 50% WP	0.70	4.5	1 934.0	7.0	1 260.8
Copper Nordox 50% WP	0.50	3.3	1 122.7	8.0	1 316.9
Copper Nordox 50% WP	0.40	6.4	924.5	10.5	1 547.7
Copper Nordox 50% WP	0.35	6.4	1 039.1	10.9	1 381.5
Kocide 101 50% WP	0.70	4.6	946.6	7.0	1 411.6
Kocide 101 50% WP	0.50	4.3	1 135.4	9.4	1 328.7
Kocide 101 50% WP	0.40	4.7	1 240.1	12.5	1 157.6
Kocide 101 50% WP	0.35	6.8	1 026.0	13.9	967.2
Copper Sandoz MZ 50% WP	0.35	5.2	1 255.6	11.9	1 021.0
Unsprayed (control)	–	41.9	908.1	17.5	946.2
LSD P = 0.05	–	5.9	NS	3.5	329.5
CV	–	37.6%	41.9%	23.3%	17.9%

One hectare = 1 330 trees.

reduced application rates of Perenox (0.35%), Copper Nordox (0.35%) and Kocide 101 (0.35%). The reduced rates of Perenox, Copper Nordox and Kocide 101 were as effective as the standard treatment (Perenox 0.7%) in controlling leaf rust (Figure 1).

In the following year 1979/80 the leaf rust epidemic in Thika River Trial II was not severe. The peak of rust epidemic occurred in July 1980 when the percent leaf rust infection was 19.64 percent (26.47% transformed) in the control plots. There was significant (at P = 0.05) reduction in the incidence of leaf rust on plots sprayed with reduced application rates of Perenox (0.35%). Copper Nordox (0.35%) and Kocide 101 (0.35%). The results are summarized in Table 4 and Figure 1.

Effect on yield: During 1978/79 in Thika Trial II plots treated with reduced application rates of Perenox (0.35%), Copper Nordox (0.35%) and Kocide 101 (0.35%) gave yields as high as the standard treatment Perenox (0.7%) and also 0.7% of the same product. There was no statistical difference at P = 0.05. In the following year (1979/80) plots sprayed with reduced rates of (0.35%) of Perenox, Copper Nordox and Kocide 101 gave yields as high as the standard treatment Perenox (0.7%) and also the full rates of (0.7%) of the same product. The results are summarized in Table 5.

Azania Trial I (Azania Estate)

The leaf rust incidence for this trial site at Azania Estate during 1978/79 was also severe. The peak of leaf rust infection occurred in July 1979 when the percent leaf rust infection on the control (unsprayed) plots reached 54.69 percent (48.16% transformed) levels.

The reduced rates of application (0.35%) of Perenox, Copper Nordox and Kocide 101 controlled leaf rust as effectively as the standard treatment Perenox (0.7%). There was no statistical difference (at P = 0.05) between the full rate (0.7%) and the reduced rate of the same product in controlling leaf rust (Figure 2).

In the following year (1979/80) the leaf rust epidemic in Azania Trial I was again severe. The peak of rust epidemic occurred in July 1980 when the percent leaf rust infection was 66.55 percent (54.89% transformed) in the control (unsprayed plots; Figure 3). There was significant (at P = 0.05) reduction in the incidence of leaf rust on plots sprayed with

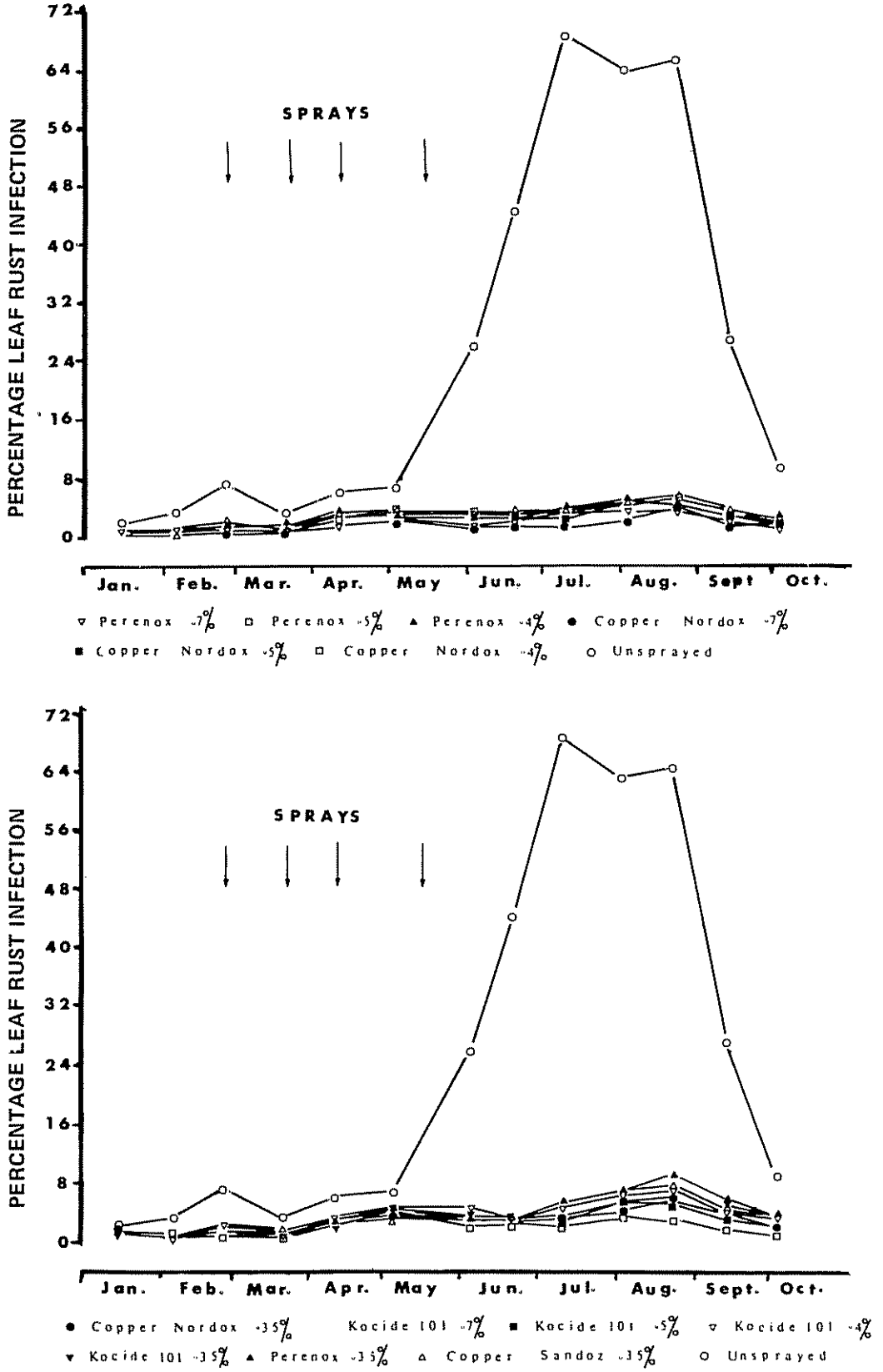

Fig. 1. Mean percent leaf rust infection at Ihika River Estate on plots sprayed with reduced rates of application of Perenox, Copper Nordox and Kocide 101 during 1979.

Table 4. Percent (Arcsin $\sqrt{\%}$) leaf rust infection at Thika River Estate (Thika River Trial II) on plots sprayed with reduced rates of application of Perenox, Copper Nordox and Kocide 101 during 1980.

Treatments	% rate of application	Analysis of % (Arcsin $\sqrt{\%}$) Leaf Rust infection on:					
		9.6.80	30.6.80	18.7.80	5.8.80	27.8.80	15.9.80
Perenox 50% WP	0.70	3.4	3.1	3.4	2.9	3.4	1.4
Perenox 50% WP	0.50	1.4	2.7	1.8	2.8	2.1	2.3
Perenox 50% WP	0.40	3.2	3.1	3.4	4.1	4.4	3.1
Perenox 50% WP	0.35	4.6	4.8	4.5	5.8	4.2	2.2
Copper Nordox 50% WP	0.70	2.1	2.1	2.6	2.8	2.1	3.3
Copper Nordox 50% WP	0.50	4.4	3.6	2.5	3.0	3.5	2.9
Copper Nordox 50% WP	0.40	4.6	4.0	4.3	3.9	3.0	3.2
Copper Nordox 50% WP	0.35	2.4	4.5	4.4	5.2	3.5	3.4
Kocide 101 50% WP	0.70	3.1	2.7	4.2	1.9	2.2	2.4
Kocide 101 50% WP	0.50	3.0	2.9	3.6	5.8	5.0	3.5
Kocide 101 50% WP	0.40	4.1	5.8	4.6	6.0	3.4	5.0
Kocide 101 50% WP	0.35	5.1	5.9	4.7	6.1	5.8	3.9
Copper Sandoz MZ 50% WP	0.35	3.1	6.9	6.6	7.7	6.5	5.8
Unsprayed (control)	–	12.6	23.7	26.4	25.2	21.7	19.2
LSD P = 0.05	–	2.5	3.8	4.5	4.1	4.0	3.3
CV	–	43.0%	49.3%	57.7%	48.8%	55.7%	52.2%

Table 5. Yield and Peak % leaf rust infection in plots sprayed with reduced rates of application of Perenox, Copper Nordox and Kocide 101 in Thika River Trial II.

Treatments	% rate of application	Peak % leaf rust infection (transformed)	Clean coffee yield kg/ha	Peak % leaf rust infection (transformed)	Clean coffee yield kg/ha
		10.7.70	1978/79	18.7.80	1979/80
Perenox 50% WP	0.70	10.0	1 933.6	3.4	1 824.5
Perenox 50% WP	0.50	10.0	1 909.8	1.8	1 846.8
Perenox 50% WP	0.40	11.1	1 964.05	3.4	1 785.7
Perenox 50% WP	0.35	13.2	1 892.3	4.5	1 797.6
Copper Nordox 50% WP	0.70	6.4	2 105.8	2.6	1 746.1
Copper Nordox 50% WP	0.50	8.3	1 961.6	2.5	1 772.4
Copper Nordox 50% WP	0.40	10.5	1 789.1	4.3	2 068.5
Copper Nordox 50% WP	0.35	10.5	1 923.9	4.4	1 693.0
Kocide 101 50% WP	0.70	8.1	2 035.4	4.2	1 944.1
Kocide 101 50% WP	0.50	9.1	2 009.4	3.6	1 965.3
Kocide 101 50% WP	0.40	12.0	1 790.1	4.6	1 899.8
Kocide 101 50% WP	0.35	10.7	1 702.2	4.7	2 080.6
Copper Sandoz MZ 50% WP	0.35	12.9	1 787.1	6.6	1 616.0
Unsprayed (control)	–	55.9	1 493.9	26.4	1 370.8
LSD P = 0.05	–	3.7	302.9	4.9	266.1
CV	–	19.5%	11.2%	57.7%	10.2%

One hectare = 1 330 trees.

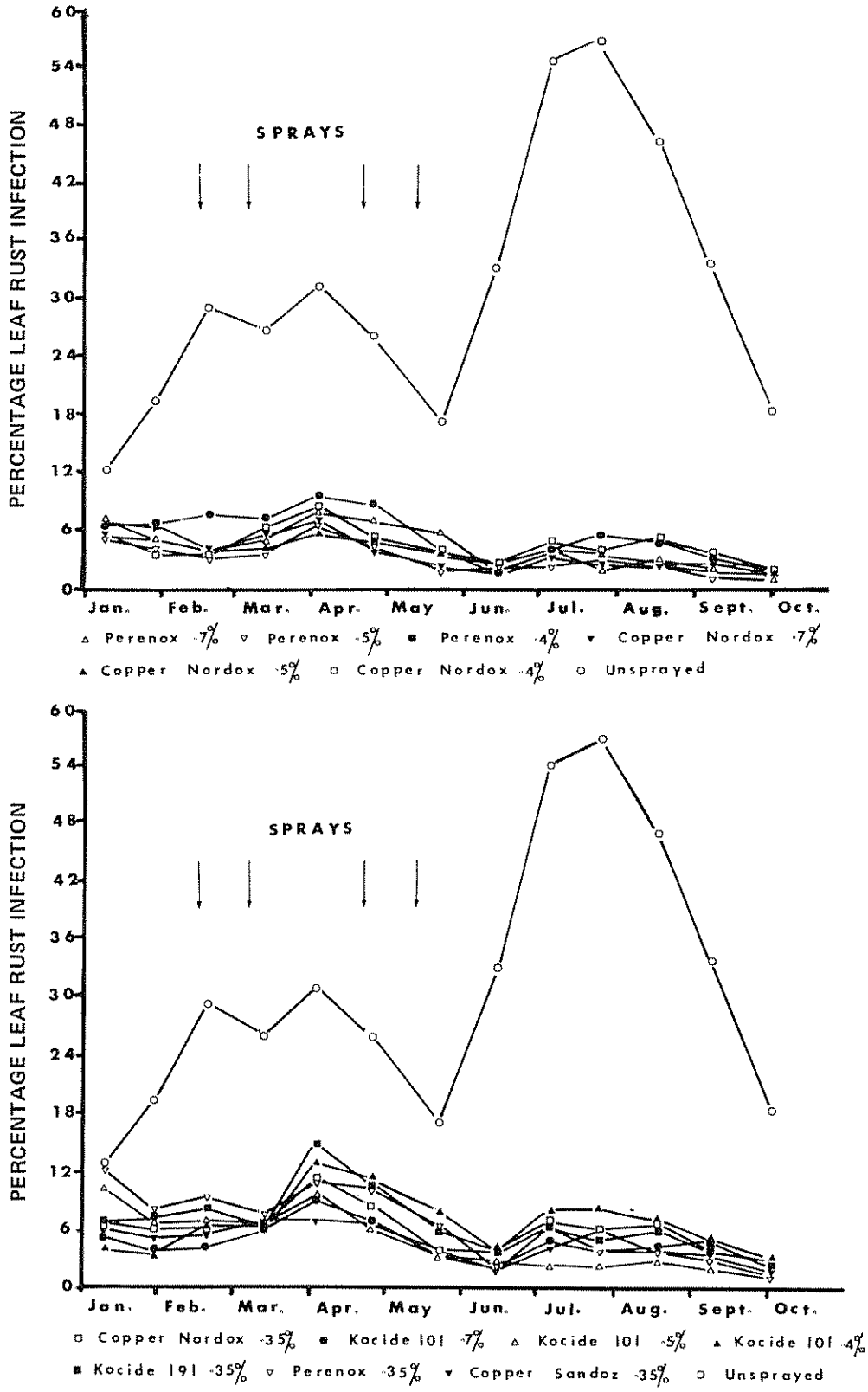

Fig. 2 Mean percent leaf rust infection at Azania Estate on plots sprayed with reduced rates of application of Perenox, Copper Nordox and Kocide 101 during 1979.

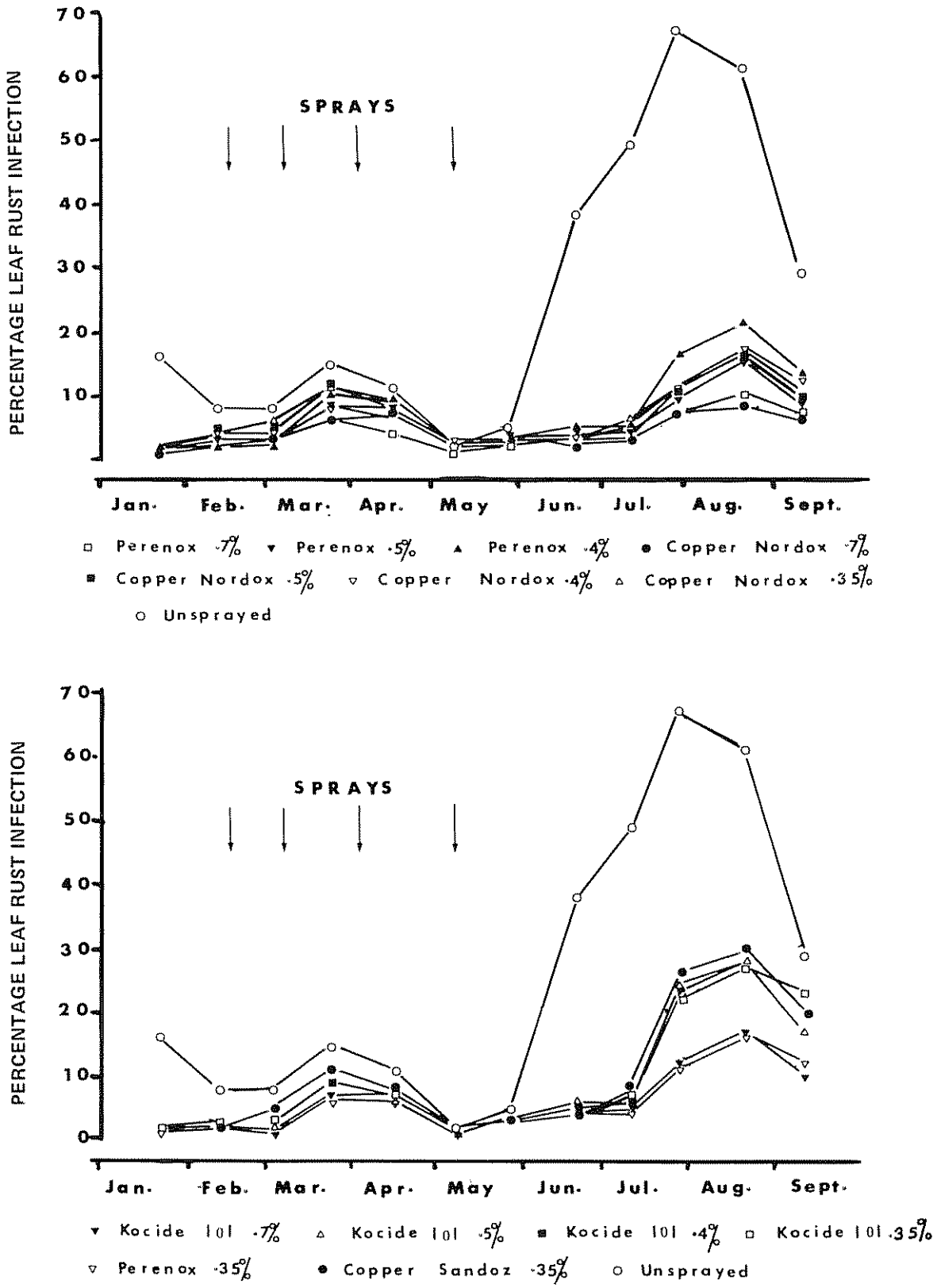

Fig 3. Mean percent leaf rust infection at Azania Estate on plots sprayed with reduced rates of application of Perenox, Copper Nordox and Kocide 101 during 1980

reduced application rates (0.35%) of Perenox and Copper Nordox but Kocide 101 at 0.35 percent did not give significant control of leaf rust compared to the standard treatment Perenox (0.7%).

Effect on yield: During the period 1978/79 in Azania Trial I, plots treated with reduced application rates (0.35%) of Perenox, Copper Nordox and Kocide 101 gave yields as high as the standard treatment Perenox (0.7%) but none of the treatments in this experiment gave yields significantly (at P = 0.05) higher than the unsprayed plots. During 1979/80 again the reduced application rates (0.35%) of Perenox, Copper Nordox and Kocide 101 gave yields as high as the standard treatment Perenox (0.7%) but none of the treatments gave yields significantly (at P = 0.05) higher than the unsprayed (control) plots. The results are given in Table 6.

Discussion

The earlier part of the year 1979 at all three different sites was particularly wet. The long rains during 1979 commenced earlier than usual in January 1979 at all three sites and continued until May. Therefore, favourable conditions for leaf rust infection occurred between January and May 1979. During 1980 the earlier part of the year was not very wet but favourable conditions for leaf rust development occurred in April and May 1980 in all three sites Table 7).

On the basis of the trials reported here the efficacy of Perenox (0.35%), Copper Nordox (0.35%) and Kocide 101 (0.35%) tested over 2 years period against leaf rust under high epidemic at three different sites was found equal to the previously recommended application rate of 0.7 percent of the same product. Therefore, the application rates of Perenox, Copper Nordox and Kocide 101 against rust could be reduced to 0.35 percent (3.8 kg/ha).

The reduced rates of application (3.8 kg/ha of Perenox, Copper Nordox and Kocide 101 had no adverse effect on the final yields. Plots treated with reduced application rates of Perenox, Copper Nordox and Kocide 101 recorded yields as high as the plots treated with the previously recommended rate of 0.7 percent (7.7 kg/ha) of the same product. There was no statistical difference at P = 0.05. The reduced rates of (3.8 kg/ha) application of Perenox, Copper Nordox and Kocide 101 have been recommended to the growers to control leaf rust in Kenya (2).

Table 6. Yield and Peak % leaf rust infection in plots sprayed with reduced rates of application of Perenox, Copper Nordox and Kocide 101 in Azania Trial I.

Treatments	% rate of application	Peak % leaf rust infection (transformed) 5.7.79	Clean coffee yield kg/ha 1978/79	Peak % leaf rust infection (transformed) 28.7.80	Clean coffee yield kg/ha 1979/80
Perenox 50% WP	0.70	12.1	1 580.8	15.2	800.5
Perenox 50% WP	0.50	9.3	1 545.9	16.6	1 066.6
Perenox 50% WP	0.40	11.6	1 659.2	23.3	782.7
Perenox 50% WP	0.35	14.0	1 534.9	18.7	994.3
Copper Nordox 50% WP	0.70	10.6	1 591.8	14.7	867.1
Copper Nordox 50% WP	0.50	11.5	1 491.4	19.4	1 047.5
Copper Nordox 50% WP	0.40	12.0	1 775.0	19.7	813.5
Copper Nordox 50% WP	0.35	14.1	1 321.9	18.9	885.4
Kocide 101 50% WP	0.70	12.6	1 669.3	19.7	817.0
Kocide 101 50% WP	0.50	9.1	1 406.4	29.9	921.3
Kocide 101 50% WP	0.40	16.5	1 645.0	27.8	786.8
Kocide 101 50% WP	0.35	14.4	1 679.1	27.6	788.5
Copper Sandoz MZ 50% WP	0.35	12.0	1 700.0	30.4	759.6
Unsprayed (control)	–	48.1	1 559.5	54.8	639.2
LSD P = 0.05	–	5.8	NS	5.9	NS
CV	–	27.6%	21.9%	17.3%	30.2%

One hectare = 1 330 trees.

Table 7. Monthly totals of rainfall from trial sites.

Months	Jacaranda Estate Rainfall mm)		Thika River Estate Rainfall (mm)		Azania Estate Rainfall (mm)	
	1979	1980	1979	1980	1979	1980
January	61.5 (13*)	46.1 (5*)	70.0 (13*)	62.0 (5*)	64.7 (12*)	64.0 (5*)
February	229.9 (7)	4.0 (1)	172.0 (6)	6.0 (2)	138.8 (6)	0.0 (0)
March	108.1 (5)	75.7 (5)	172.0 (5)	72.5 (6)	122.9 (5)	51.5 (4)
April	341.0 (23)	139.8 (12)	236.0 (22)	64.0 (9)	164.3 (17)	88.6 (12)
May	149.3 (10)	323.8 (21)	195.5 (16)	244.0 (15)	176.3 (12)	345.3 (18)
June	26.9 (4)	8.5 (4)	47.0 (4)	7.9 (3)	48.8 (4)	1.8 (1)
July	27.3 (7)	3.8 (2)	3.1 (2)	1.0 (1)	1.3 (1)	2.5 (1)
August	21.1 (5)	18.3 (4)	8.9 (2)	13.0 (2)	25.7 (5)	6.7 (1)
September	2.4 (1)	5.4 (3)	3.9 (2)	0.0 (0)	1.3 (1)	0.0 (0)
October	31.4 (8)	38.6 (5)	29.8 (7)	39.5 (4)	30.0 (5)	25.8 (4)
November	159.2 (12)	383.1 (16)	199.5 (12)	280.5 (21)	214.2 (13)	407.6 (16)
December	38.1 (10)	40.1 (6)	8.9 (4)	10.0 (4)	9.5 (3)	30.7 (4)
Total	1 196.2 (107)	1 087.2 (84)	1 156.7 (95)	800.4 (72)	997.8 (84)	1 024.5 (66)

* Figures in parenthesis are number of rainy days.

Summary

During the 1979 and 1980 seasons and under high Coffee Leaf Rust epidemic, Cuprous oxides (Perenox and Copper Nordox) and Cupric hydroxide (Kocide 101) were found effective against leaf rust at reduced application rate of 0.35 percent (3.8 kg/ha) at three different sites

Plots sprayed with reduced rates of application (0.35%) of Perenox, Copper Nordox and Kocide 101 gave yields as high as the plots sprayed with the previously recommended rate of 0.7 percent of the same product. Therefore, it has been recommended to use 3.8 kg/ha of Perenox, Copper Nordox and Kocide 101 to control leaf rust in Kenya.

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