

SOME ASPECTS OF THE CONTROL OF *KOLEROGA* OR *MAHALI* DISEASE OF THE ARECA PALM

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Mahali or *Koleroga* disease of arecanuts is the most serious disease of areca palms in Malabar and South Kanara of the Madras Presidency. There are about 80,000 acres under Areca in the former and 20,000 acres in the latter district. In addition to these localities the disease is also prevalent in the North Kanara district of Bombay and in the states of Mysore, Cochin and Travancore. The disease first attracted the attention of the Mysore Mycologist Dr. Coleman who investigated it and published his results in the form of a bulletin in the year 1910*. It was shown that the disease could be effectively controlled by proper spraying. Our province had just then realised the necessity for a mycologist of its own and appointed Mr. McRae as the Madras Mycologist in 1910. Some time after he took up his post, he found the disease widely prevalent in certain arecanut areas in Malabar. He conducted spraying trials and demonstrated to the areca growers of Malabar that the disease could be effectively controlled. The propaganda was so successful that areca growers in Malabar were soon conversant with the measures advocated by the department. Since then the demand for the chemicals necessary for the spraying has fostered a trade in these articles so that stocks are obtainable in many of the petty shops in areca areas of Malabar.

History of the disease in South Kanara. Sporadic outbreaks of *Koleroga* were reported from time to time from South Kanara especially from the ghat areas bordering Mysore. A few spraying trials beginning from as early as 1913 were conducted in this district so that the ryots of the locality might see for themselves the success of the measures adopted. In spite of vigorous propaganda by the department, especially in the years 1934 and 1935 when 116,150 and 385,000 trees were sprayed under the supervision of departmental officers, the areca growers here were tardy in taking up the measures advocated. This could be attributed to the following causes:

(1) The disease had not appeared there in epidemic form involving large areas causing heavy loss.

(2) The rainfall in S. Kanara is much heavier than in Malabar being about 150 inches in the coastal areas and over 200 inches in the Malnad areas. In the year 1931, in one of these latter areas, the rainfall in the

* Coleman, L. C.—Mycological Series, Bulletin No. 2, Department of Agriculture, Mysore State, 1910.

south west monsoon alone was 200 inches, August contributing 95 inches though the average for this month is only about 25 inches.

(3) The climbers available in South Kanara had not the same training as their brethren in Malabar and found it difficult to climb up the slippery palms for the second spraying recommended to be given in July.

Such was the situation in South Kanara when in June 1936, the disease broke out in a very serious form and spread rapidly. Just before the outbreak of this epidemic, little did these ryots realise that they were on the verge of disaster. The disease was so serious and widespread and came upon them when they were least prepared to meet the situation. Many were without sprayers and could not get them when needed. Those who were able to get sprayers and spray their gardens were able to save their crop, the amount saved depending on the time of spraying. Those who gave the first spraying before the appearance of the disease followed by a second spraying in July—August were able to save the whole crop, while those who conducted spraying only after the first appearance of the disease were able to save only 50 to 75% of the crop. It was a very pathetic sight to see the total loss of crop in some of the unsprayed gardens in centres like Hathyadka.

While the disease had caused a general calamity among the areca growers, it served at least one good purpose. It taught such of those growers who were aware of spraying on the need for preparedness and prompt action. Those hitherto ignorant of the treatment or looked on it with indifference or suspicion learnt to their cost the existence of an effective remedy, which they had not availed of. Since this catastrophe, there has been an all round awakening and a general willingness to follow departmental advice. During the year 1937, about 80% of the areca plantings were sprayed.

It will thus be seen that the difficulties were not insurmountable. The climbers are now better trained and are able to manipulate the sprayers well. New types of sprayers have come into the market. In one type, a delivery hose of about 60 feet is attached so that the climber has simply to carry the nozzle up the tree for spraying. Climbers here prefer this to the one gallon sprayer which is carried on the back. In former years, the climbers had to go right up to the top to spray the bunches as the spray was delivered in the form of a mist and travelled only a short distance. Now nozzles with jet spray travelling over comparatively long distances are available. The climbers therefore need climb only a short way especially during rainy weather. The spraying done by the areca growers in South Kanara is only by this method. Though there is wastage of 30 to 50 per cent. of the mixture, it enables them to spray their trees more easily a second time during the break in the heavy rains and in a much shorter time.

The adhesive hitherto recommended for the Bordeaux mixture was resin dissolved in washing soda. As long as there was only one spraying necessary as in most parts of Malabar there was no complaint against this mixture

except its cost. However, when the need for a second spraying arose, the areca cultivators found it difficult to prepare the resin adhesive within the limited time at their disposal during the short breaks in the heavy monsoon. As early as 1921—22, the mycological section of the Madras Agricultural Department had found during the coffee spraying experiments in Coorg that casein was a good adhesive for Bordeaux mixture. During the years 1934 and 1935, vegetable oils were tried as spreaders to Bordeaux mixture for the control of *Koleroga* and were found satisfactory.

Spraying experiments in South Kanara. Such was the state of our knowledge when in 1936, the disease broke out in a virulent form in very many parts of South Kanara. Some of the growers had taken to spraying with resin mixture, some with casein mixture and many with oil mixture, this being the easiest to prepare and the cheapest. Though all these adhesives were generally found to be successful in the control of the disease, when the question about the relative merits of these adhesives arose, well analysed experimental data for pronouncing any definite opinion were lacking.

Two series of experiments were laid out in two different places in South Kanara.

A tabular statement is given as Appendix I showing the treatments tried, the percentage of nut fall caused by *mahali*. The object of these experiments was to get definite evidence on the following points :

(1) Whether one spraying just when the disease makes its appearance in the locality is able to control the disease as effectively as two sprays, one just before the monsoon and the other six weeks later.

(2) Whether 1% Bordeaux with adhesives controlled the disease as effectively as 2% Bordeaux with adhesives.

(3) To determine the relative merits of resin, casein, oil and fish-oil-resin soap as adhesives to Bordeaux mixture.

(4) Whether 2% Bordeaux mixture without adhesives controlled the disease as effectively as 2% Bordeaux mixture with adhesives.

(5) Whether cuprous oxide was as effective as Bordeaux mixture.

Weekly records of nut-fall were maintained from the time of the first spraying to the end of the harvest and fallen nuts were examined and classified as due to *Mahali* and other causes. A summary of the statistical analysis of the results obtained is furnished separately as Appendix I.

The following inferences are drawn from the results obtained :

(1) The control plots show the heaviest infection.

(2) Cuprous oxide is a poor substitute for Bordeaux mixture.

(3) Two sprays with Bordeaux mixture controls the disease better than a single spray.

(4) 2% Bordeaux mixture is more efficient than 1% mixture in the single spraying series.

(5) Oil or casein in combination with 2% and 1% strengths of Bordeaux mixture effectively controls the disease.

(6) Oil and casein are found to give better control than resin.

(7) 2% plain Bordeaux without adhesive is found to give as good a control as 2% Bordeaux with oil or casein.

A comparative statement of the cost of chemicals required for one spraying of an acre of areca garden with 2% Bordeaux mixture with the important adhesives tried is given as Appendix II.

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APPENDIX I.

Treatment effects on infection per plant in Vittal and Kandigai.

Serial No.	Treatment combinations.		Number of sprays.	Percentage of infection per tree.	No. of units. (1 unit = 10 trees.)
	Mixtures used.	Adhesive per 100 gallons.			
1.	Bordeaux mixture 1%	Resin soda (8 lbs. + 4 lbs.)	2	5.8*	2
2.	"	Casein (2 lbs.)	2	2.5*	3
3.	"	Coconut oil ($\frac{1}{2}$ gallon)	2	0.7*	3
4.	Bordeaux mixture 2%	Resin soda (8 lbs. + 4 lbs.)	2	5.4*	4
5.	"	Casein (2 lbs.)	2	8.8	3
6.	"	Coconut oil ($\frac{1}{2}$ gallon)	2	2.9*	3
7.	Bordeaux mixture 1%	Resin soda (8 lbs. + 4 lbs.)	1	32.0	4
8.	"	Casein (2 lbs.)	1	12.5	3
9.	"	Coconut oil ($\frac{1}{2}$ gallon)	1	17.0	2
10.	Bordeaux mixture 2%	Resin soda (8 lbs. + 4 lbs.)	1	6.2*	2
11.	"	Casein (2 lbs.)	1	3.3*	3
12.	"	Coconut oil ($\frac{1}{2}$ gallon)	1	2.2*	1
13.	"	Fish oil resin soap (10 lbs.)	2	7.0*	3
14.	Cuprous oxide 1%	Casein (2 lbs.)	2	14.6	4
15.	Bordeaux mixture 2%	Niger oil ($\frac{1}{2}$ gallon)	2	2.5*	3
16.	"	Without adhesive	2	2.8*	3
17.	Control	No spraying	-	34.9	3

* Effective treatments not significantly different from each other. A block of 17 units was rejected as there was no disease in that block.

Note:— For the double spraying series the first spraying was given between the 23rd and 30th May and the second spraying between the 23rd and 30th July 1937. For the single spraying series, the spraying was given between the 3rd and 8th July 1937. The monsoon in 1937 was particularly late as it commenced only on the 10th June.

Analysis of variance of Treatment effects on mahali infection in Vittal and Kandigai experiments.

Variations due to	Degree of freedom	Sum of squares	Mean square
Between treatments	16	5, 26, 99.89	3293.7
Remainder	28	2, 31, 72.36	"
Between plots	44	7, 58, 72.25	"
Within plots	445	13, 63, 75.39	306.48
Total	489	21, 22, 47.64	

P < .01

The treatment effects are significant

Main effects of treatment.		Infection per plant.
Bordeaux mixture	{ 1% 13 } { 2% 5.1 }	Significant.
Adhesives	{ Resin 14.5 }	Significant.
	{ Casein 6.8 }	Not significant.
	{ Oil 5.2 }	
Number of sprayings	{ Single 14.9 } { Double 4.3 }	Significant.

APPENDIX II

Comparative cost of chemicals and adhesives required for spraying 500 trees.
(50 gallons of 2% Bordeaux mixture.)

Resin Bordeaux.			Oil Bordeaux.		
		Rs.			Rs.
Copper sulphate	10 lbs.	1 14 0	Copper sulphate	10 lbs.	1 14 0
Lime	10 "	0 5 0	Lime	10 "	0 5 0
Resin	4 "	0 12 0	Niger oil	8 oz.	0 1 0
Soda	2 "	0 4 0			
Total.		3 3 0			2 4 0

Casein Bordeaux.			Plain Bordeaux.		
		Rs.			Rs.
Copper sulphate	10 lbs.	1 14 0	Copper sulphate	10 lbs.	1 14 0
Lime	10 "	0 5 0	Lime	10 "	0 5 0
Casein	1 lb.	0 4 0			
Total.		2 7 0			2 3 0

EXTRACTS

Soil Erosion-Bunding Classes. In 1813 Jefferson wrote of his farm in Virginia "our country is hilly and we have been in the habit of plowing in straight rows, whether up or down hill..... and our soil was rapidly running into the rivers. We now plow horizontally, following the curvature of the hills and hollows on head level. Every furrow thus acts as a reservoir to receive and retain the water, all of which goes to the benefit of the growing plant instead of running off into the stream." A few careful cultivators appreciated the damage due to erosion but Americans as a class were indifferent. There was always virgin land available. Limit was reached. A century and a quarter later, it was noticed that "while the United States formerly produced a thousand million bushels of wheat in a single year, and had substantial surplus for export, now that was being imported from Canada. President Roosevelt set up a Commission to warn the country that the public estate would entirely disappear in another hundred years, unless nation-wide conservation steps were taken early." Some of the findings of the Commission were staggering as under.

1. Forest Resources are reduced by half.
2. One billion acres of land has lost, by erosion or wind from one to three fourths of the top soil.
3. One hundred million acres of the finest agricultural land will never again be tilled.
4. Three million tons of solid material are washed out of fields and pastures every year by water erosion. Morris L. Cooks, sometime chairman of the National Resources Board, sums up: "Just as with bodily diseases such as cancer