

Some Experiments on the Fungicidal Control of Leaf Diseases of *Sorghum*

by

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Introduction: *Sorghum* (*Sorghum vulgare*) is the most important millet cultivated in Tamil Nadu and is subject to a number of diseases like smuts and leaf spots. Amongst the leaf diseases, leaf spot caused by *Cercospora sorghi* Ell & Ev. and leaf blight caused by *Bipolaris turcicum* (Pass) Shoemaker, are of major importance and are widely prevalent in this state.

A survey was conducted in the districts of Madurai, Ramanathapuram and Coimbatore in Tamil Nadu to assess the prevalence and intensity of these diseases. It was found that the leaf blight caused by *Bipolaris turcicum* was comparatively more prevalent in most of the places visited in these districts than the leaf spot caused by *Cercospora sorghi*. These leaf diseases affect both rainfed and irrigated crops and assume serious proportions during spells of wet weather resulting in loss of yield and deterioration in fodder quality. In China, Porter (1926) recorded a loss of 5% in yield due to leaf spot disease caused by *Cercospora* sp. The exact figures relating to loss caused by leaf diseases in *sorghum* in this State are not available; but considering their wide prevalence and often with high intensity the loss must be substantial. In order to minimise the heavy losses caused by these leaf diseases investigations have been undertaken for evolving effective control measures. Field experiments were conducted in order to test the relative efficacy of various fungicides in the control of the above leaf diseases and the observations made and the results obtained are presented in this paper.

Materials and Methods: The experiments were conducted during 1961 (rainfed crop) and 1962 (irrigated crop) at Central Farm, Agricultural College and Research Institute, Coimbatore. The fungicides tested during the first and the second year experiments are furnished below :

1961 Experiment: (Rainfed crop - CO-1 cholam)

1. Zinc Ethylene bisdithio carbamate (Dithane Z. 78)	...	0.15%
2. N trichloro methyl mercapto-4 Cyclohexene dicarboximide (Flit 406)	...	1.20%
	...	0.20%
3. Sulphur dust	...	60 lb/ac.
4. Ferric dimethyl dithiocarbamate (Ferbam)	...	0.50%

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5. Zinc dimethyl dithiocarbamate (Ziram),	... 0.20%
6. Copper oxychloride (Micro Cop)	... 0.25%
7. Copper oxychloride (Colloidal Copper)	... 0.25%
8. Sulphur (Wettable)	... 0.50%
9. Disodium ethylene bisdithio Carbamate (Dithane D. 14)	... 0.15%+ Zinc Sulphate
10. Bordeaux Mixture	1.00%
11. Copper oxychloride (Parry Cop)	0.25%
12. Control - No treatment	

The above fungicides were applied at monthly intervals.

1962 Experiment (Irrigated - CO 18 cholam)

	Strength	Intervals of spraying
1. Bordeaux Mixture	1%	Weekly
2. -do-		Fortnightly
3. Micro cop	0.33%	Weekly
4. -do-		Fortnightly
5. Flit 406	0.33%	Weekly
6. -do-		Fortnightly
7. Dithane Z 78	0.16%	Weekly
8. -do-		Fortnightly
9. Dithane M 22	0.16%	Weekly
10. -do-		Fortnightly
11. Control - No treatment		

The fungicides were applied with hand operated rocker type sprayers at 100 gal/acre taking care to avoid drift to other plots. Sulphur dust was applied at the rate of 60 lb/acre by means of muslin cloth bag during the still morning hours. In the rainfed crop the fungicides were applied thrice at monthly intervals and the first application was given 60 days after sowing. For the irrigated crop the various fungicides were applied both at weekly and fortnightly intervals and the first round of spraying was given 43 days after sowing. The weekly sprayed plots received 7 spraying in all while the fortnightly sprayed plots received 4 sprayings. The plots of 1961 experiment received only a basal dressing of farm yard manure while the plots of 1962 experiment received 200 lb of ammonium sulphate, 112 lb of super phosphate besides 10 tons of farm yard manure.

The incidence of leaf infection was recorded before each spraying. In the experiment conducted during 1961 the first three leaves of five plants selected at random in each plot were graded for leaf spot and leaf blight infection into three groups viz., Light, Medium and Heavy representing

roughly 25%, 50% and 75% infection respectively. In the experiment conducted during 1962 the following methods of grading for infection was adopted. Five plants were selected at random from each plot and the intensity of infection in the first four leaves of the plants was recorded under 5 grades viz., 1, 2, 3, 4 and 5 representing roughly 10%, 25%, 50%, 75% and 100% infection for both the diseases.

While harvesting, an area of 20' x 5' was marked out for 1961 experiment and an area of 12' x 8' was marked out for 1962 experiment in the centre of each plot and the earheads and stalks lying within the marked out area were carefully harvested. The earheads were then dried, threshed, cleaned and final grain weight was recorded in kilogram.

Results: It will be seen from the results of the 1961 experiment (*vide* Table 1) that Dithane Z 78 treated plots have recorded the highest grain yield

TABLE 1. Fungicidal Trial 1961 (Rainfed crop)

Crop:	Cholam CO 1	Layout:	Randomised Block	
		Replications:	6	
Date of sowing:	30-8-1961	Treatments:	12	
Date of harvest:	17-1-1962	Size of plot:	Nett: 20' x 5'	

Treatments	Mean % of <i>Cercospora</i> infection	Mean % of <i>Helminthosporium</i> blight	Mean yield per plot (kg)	Yield (kg/acre)
1 Dithane Z 78	47.77	45.27	1.558	677.730
2 Flit 406	38.61	44.16	1.365	599.775
3 Sulphur dust	46.77	44.71	1.250	546.750
4 Ferbam	44.44	44.44	1.085	471.975
5 Ziram	39.99	43.05	1.235	537.225
6 Microcop	37.49	33.60	0.868	377.580
7 Collidal copper	34.16	31.94	0.882	383.700
8 Wettable sulphur	41.38	43.05	1.372	596.820
9 Dithane D 14	41.44	42.77	1.442	627.270
10 Bordeaux mixture	28.32	31.66	0.977	424.975
11 Parry cop	34.16	40.83	1.083	441.105
12 Control	58.88	49.16	1.225	530.700

Whether statistically significant:	Yes	Yes
Standard Error:	3.46	2.66
Critical Difference:	9.78	7.52

Conclusion: (1) 10, 11, 7, 6, 2, 5, 8, 9, 4, 3, 1, 12 (2) 10, 7, 6, 11, 9, 5, 8, 2, 4, 3, 1, 12

(3) 1, 9, 8, 2, 3, 5, 12, 4, 11, 10, 7, 6

viz., 27.7% over control which is significantly superior to Ferbam, Parry cop, Bordeaux mixture, Colloidal copper and Micro cop treated plots. In respect of *Cercospora* leaf spot all the treated plots showed significantly less disease than control. Treatments with Copper fungicides *viz.*, Bordeaux Mixture, Parry cop, Colloidal copper and Micro cop gave better control of *Cercospora* leaf spot as well as *Helminthosporium* blight. But the above treatments have recorded the lowest yield as compared to other fungicides and control. This appears to be due to spray injury caused by the copper fungicides on the *sorghum* plants. There was scorching of foliage due to spray injury which is likely to be mistaken for mite infestation when seen from distance. In this experiment the spray injury was mild because of longer spraying intervals as compared to the second experiment and hence the fungal spots could be distinguished from the spray injury.

In the second experiment conducted during 1962 (*vide* Table 2) Dithane M 22 sprayed plots at fortnightly intervals have recorded the highest

TABLE 2. Fungicidal Trial 1962 (Irrigated crop)

Crop:	Cholan CO. 18	Layout:	Randomised	
Date of sowing:	15-2-1962	Replications:	4	
Date of harvest:	22-5-1962	Treatments:	11	
		Size of plot:	Nett: 12'x8'	
Treatments	Mean % of <i>Cercospora</i> infection	Mean % of <i>Helminthosporium</i> blight	Mean yield per plot (kg)	Yield (kg/acre)
Bordeaux mixture 1% weekly			0.730	328.5
Bordeaux mixture 1% fortnightly	Infection could not be recorded due to severe scorching		0.845	382.5
Microcop weekly			0.125	58.5
Microcop fortnightly			0.463	207.0
Flit 406 weekly	8.25	6.62	1.113	499.5
Flit 406 fortnightly	13.38	7.75	1.820	373.5
Dithane Z 78 weekly	4.38	4.75	1.218	549.0
Dithane Z 78 fortnightly	5.78	6.81	0.983	441.0
Dithane M 22 weekly	6.44	5.37	1.205	544.5
Dithane M 22 fortnightly	12.06	6.00	1.540	693.0
Control	26.44	11.31	1.128	508.5
Whether statistically significant:	Yes	No	Yes	
Standard Error:	2.28		0.145	
Critical Difference	6.77		0.419	

Conclusion: 11, 6, 10, 5, 9, 8, 7

10, 7, 9, 11, 5, 8, 2, 6, 1, 4, 3

increase in yield of 36.01% over control and the difference is just short of statistical significance but it was significantly superior to Flit 406, and the Copper fungicides treated plots. As regards control of *Cercospora* leaf spot Flit 406, Dithane Z 78 and Dithane M 22 treated series have recorded significantly less incidence as compared to control and Dithane Z 78 has recorded the maximum control. The same trend is also seen in respect of leaf blight but the treatment differences are not statistically significant as there was no appreciable incidence of the disease. However grading for disease infection could not be done in the case of plots treated with Copper fungicides due to the heavy scorching caused by spray injury. Even in the 1961 experiment considerable spray injury was observed in all the plots treated with Copper fungicides, however, it was not so severe as in 1962 experiment in which sprayings were given at shorter intervals.

With a view to get a rough indication of the difference, if any, in fodder value of the leaves collected from plots sprayed with Dithane M 22 and control which exhibited 6.44% and 26.44% infection respectively, chemical analysis was carried out. The results of the chemical analysis are furnished below.

Chemical analysis of infected and healthy leaves (% on moisture free basis)

	Control (No treatment with infection value of 26.44%)	Dithane M 22 (Leaves with mean infection value of 6.44%)
Ash	17.10	16.40
Crude protein	12.33	13.23
Ether extractives	1.98	1.89
Crude fibre	19.05	18.25
Carbohydrates (By difference)	49.54	50.23

There is reduction in crude proteins and carbohydrates contents in leaves from (untreated) control plots:

Discussion: Two leaf spot diseases are commonly prevalent at Coimbatore. Among these the *Cercospora* leaf spot appears in a severe form than the *Helminthosporium* leaf blight. The experiments reported in this paper, indicated that these diseases are amenable to control by fungicides. The dithiocarbomates appear to be more efficient in controlling the diseases. Disease control resulted in increased grain yield and slightly increased fodder value. Dithane Z 78 and Dithane M 22 recorded markedly higher yields than untreated control. The yield increases were not entirely due to disease control but the fungicides seemed to have a direct stimulatory effect on the crop.

One important and interesting finding that emerges from the above experiments and which deserves special comment is the fact that the Copper fungicides have proved highly phytotoxic to sorghum plants. It was also observed that all the popular varieties viz., CO 1, CO 2, CO 4, CO 18, CO 11 and CO 19 tested under pot culture conditions were found susceptible to copper spray injury. This finding does not seem to have been reported in literature so far, although phytotoxicity of copper fungicides have been reported on several other crops such as apple by Dutton (1923), Peaches and hops by Martin (1948) on tobacco by Hopkins (1934), on tomato by Wilson and Runnels (1937), on papaw by Simmonds (1935), on rose and plums by West Cott (1949), on maize (Anon 1954) and on rice by Okamoto (1953).

Summary: Field experiments were conducted during 1961 and 1962 for the control of leaf diseases of sorghum caused by *Cercospora sorghi* and *Bipolaris turcicum* by the use of fungicides. All the non-copper fungicides reduced the disease intensity to a significant extent, the fungicides Dithane Z 78 and Dithane M 22 also increased grain yields over untreated control. The copper fungicides caused severe scorching of the sorghum foliage and also considerably depressed the yield.

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