

## CHEMICAL CONTROL OF SOYBEAN RUST IN THAILAND

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**ABSTRACT:**— Soybean rust caused by *Phakopsora pachyrhizi* Syd. was found as the most serious disease in Thailand. The damage and losses in yield ranged from 10–15% in the dry season and complete loss of yield was observed on some imported varieties and also on local varieties in the rainy season. A number of fungicides were screen tested and selected for the controlling of this disease. Piperazin W. 524, Oxycarboxin,  $Mn^{++}Zn^{++}$  bisdithiocarbamate ion and Manganese ethylene bisdithiocarbamate can be used effectively for the controlling of soybean rust at the rate of 1,500 ml, 1.0 lb, 1.5 lb and 1.0 lb per acre respectively if applied 5 sprays with 5 day intervals. The first sprays should be done 30 days after germination of the seed. No synergistic effects were observed on Manganese ethylene bisdithiocarbamate combined with tested systemic fungicides.

### INTRODUCTION

Soybean rust caused by *Phakopsora pachyrhizi* Syd., is now listed as the most serious disease in Thailand. It is present throughout the growing season (July to November) at all locations, but most prevalent in September and October when rains are most frequent. It can cause serious defoliation, and total losses of yield was observed on some imported varieties during the rainy season. During the dry season crop (January-April) the yield losses may amount to 10 to 15% for SJ1 and SJ2 varieties. The disease has been reported in Thailand since 1966 (Puckdeedincan 1966). The disease has not

been extensively studied. There are very few reports on chemical control of soybean rust. Experiments with spraying for soybean rust control have been reported from Taiwan and Japan (Hung and Liu 1961, Kitani et al. 1960). At the present, control measures especially the use of fungicides, are being established. The paper reports primarily on the studies of chemical control by experimenting with different methods of spraying and various fungicides.

### MATERIAL AND METHOD

A total number of 12 fungicides (Table 1) were tested and screened for controlling of soybean rust during 1971-1975 in the rainy season at Mae Cho Experiment Station, Chiang Mai. There were 5 replications of each fungicide and also a control plot sprayed with water only. Each plot was 3x5 m with 6 rows. Seeds of soybean variety SJ1 were planted in the middle of July every year. The first sprays were applied 30 days after germination of soybean seed. Tenac sticker and spreader was added at the rate of 1:1,000 in each treatment. Observations on defoliation and disease rating were made a day before each application and 5 days after the last application. The 4 middle rows of each plot were harvested for seed yield. Seeds were dried to 8.5-9.0% moisture content before weighing.

### RESULT AND DISCUSSION

It was observed that only a small number of the lower leaves were infected with rust pustules on the under side at the time of the first spraying, but the disease developed rapidly in some of the plots before the second spraying. The fungicides used in the spraying of these plots were ineffective. Piperazin W. 524, Oxycarboxin, Manganese ethylene bisdithiocarbamate and  $Mn^{++} Zn^{++}$  ethylene bisdithiocarbamate ion were very effective fungicides for controlling of soybean rust among the 12 tested fungicides. They were retested for further studies.

TABLE 1. Fungicides tested against soybean rust

Fungicide	Rate of application per acre (Product rate)
Benomyl	0.6-2.0 lb
DPX 10	0.5-1.0 lb
Piperazin W. 524	1,250-2,500 ml
Tetrachloroisophthalonitril	2.0-4.0 lb
Triphenyl tinhydroxide	2.0 lb
Manganese ethylene bisdithiocarbamate	2.0 lb
Mn <sup>++</sup> Zn <sup>++</sup> ethylene bisdithiocarbamate ion	2.0 lb
Calcium poly sulphide	3.5 lb
Oxycarboxin	1.0-2.0 lb
Streptomyces piumogenus	1.0 lb
Thiophanate	1.5-2.0 lb
Thiabendazole	1,200 ml

TABLE 2. Average yield per hectare and average seed weight of SJ1 soybean after spraying with Manzate-D and Manzate-D combined with 5 other fungicides, using 5 applications with 5 day intervals

Fungicide combination	Rate of application lb or ml/acre (Product rate)	Yield kg/ha	Seed weight g/100 seeds
Manganese ethylene bisdithiocarbamate	2 lb	2,195.96 a	12.23 a
.. + Piperazin W. 524	2 lb + 1,250 ml	2,496.50 a	13.23 a
.. + Oxycarboxin	2 lb + 1 lb	2,472.31 a	12.65 a
.. + Thiabendazole	2 lb + 273 ml	2,226.28 a	12.20 a
.. + Thiophanate	2 lb + 1.5 lb	2,113.34 a	12.13 a
.. + DPX 10	2 lb + 0.5 lb	2,079.55 a	12.61 a
Unsprayed	—	666.79 b	7.20 b
		C.V. 17%	C.V. 5%

Any two means followed by the same letter are not significantly different at 5% by Duncan's new multiple range test.

TABLE 3. Average yield per hectare and average seed weight of SJI soybean after spraying with Manzate-D using 5 applications with 5, 7 and 10 day intervals

Spraying interval days	Yield kg/ha	Seed weight g/100 seeds
5	1,860.77 a	11.02 a
7	1,641.46 ab	10.41 b
10	1,109.15 b	8.58 c
Unsprayed	729.98 bc	7.23 c
	C.V. 19.94%	C.V. 6%

Any two means followed by the same letter are not significantly different at 5% by Duncan's new multiple range test.

Five systemic fungicides were tested for synergistic effects when combined with Manganese ethylene bisdithiocarbamate. The spraying was repeated 5 times at 5 day intervals and showed no synergistic effects. Yield and seed weight in all of the treatments showed a significant increase when compared with unsprayed plot, but there was no difference in yield and seed weight among the different fungicide treatments (Table 2).

Spraying intervals for soybean rust control were also studied by spraying with Manganese ethylene bisdithiocarbamate 2 lb per acre with 5 sprayings. There was no difference in yield between the 5 day interval and the 7 day interval, but the difference in seed weight was significant. There was also no difference in yield between the 7 day interval and the 10 day interval but the difference in seed weight was significant (Table 3). The most effective spraying interval for Manganese ethylene bisdithiocarbamate was the 5 day interval which gave both the highest yield and seed weight.

The number of application for soybean rust control were studied. The selected fungicides, Piperazin W. 524, Oxycarboxin and Manganese ethylene bisdithiocarbamate were applied 30 days after germination. The number of application did affect and increase the yield and seed weight significantly. Increasing of the number of application also showed an increase in

yield and seed weight. There were some significant differences in seed weight between 5 applications and 7 applications if sprayed with Manganese ethylene bisdithiocarbamate or Oxycarboxin but no difference in yield in all the treatments (Table 4).

Three rates of application of three selected fungicides were studied. The first sprays were applied 30 days after germination of the soybean seed and repeated 5 sprays at 5 day intervals. The results showed no interaction between fungicides and rate of applications. There were significant differences among the three fungicides. Average yield per hectare of soybean treated

TABLE 4. Average yield per hectare and average seed weight of SJI soybean after spraying with 3 fungicides, using 3, 5 and 7 applications with 5 day intervals

No. of application and fungicide	Rate of application lb or ml/acre (Product rate)	Yield hg/ha	Seed weight g/100 seeds
<b>3 applications</b>			
Piperazin W. 524	2,500 ml	1,141.42 c	8.40 d
Oxycarboxin	2 lb	1,092.94 c	9.06 d
Manganese ethylene bisdithiocarbamate	2 lb	951.79 cd	8.05 ef
Unsprayed	—	649.31 d	7.83 ef
<b>5 applications</b>			
Piperazin W. 524	2,500 ml	1,714.04 ab	13.25 a
Oxycarboxin	2 lb	1,613.25 ab	10.61 c
Manganese ethylene bisdithiocarbamate	2 lb	1,580.99 ab	10.76 c
Unsprayed	—	633.18 d	7.48 f
<b>7 applications</b>			
Piperazin W. 524	2,500 ml	1,879.46 a	13.75 a
Oxycarboxin	2 lb	1,835.07 a	12.35 b
Manganese ethylene bisdithiocarbamate	2 lb	1,464.03 b	12.11 b
Unsprayed	—	661.46 d	7.80 ef
		C.V. 16%	C.V. 5%

Any two means followed by the same letter are not significantly different at 5% by Duncan's new multiple range test.

TABLE 5. Average yield per hectare of SJI soybean after spraying with 3 fungicides at 3 rates of application compared with unsprayed treatment all using 5 applications with 5 day intervals

Fungicide	Rate of application				Mean
	High	Medium	Low	Unsprayed	
Piperazin W. 524	1,395.17	1,682.79	1,427.13	493.16	1,250.06 a
Mn <sup>++</sup> Zn <sup>++</sup> ethylene bisdithiocarbamate ion	1,368.44	1,302.77	1,185.05	536.70	1,098.24 ab
Manganese ethylene bisdithiocarbamate	1,154.63	1,101.45	1,162.05	556.95	993.77 b
Mean	1,306.08 a	1,362.34 a	1,258.08 a	529.60 b	
					C.V. 22.65%

Any two means followed by the same letter are not significantly different at 5% by Duncan's new multiple range test.

with Piperazin W. 524 was highest but did not differ from Mn<sup>++</sup>Zn<sup>++</sup> ethylene bisdithiocarbamate ion. There was also no difference between Mn<sup>++</sup>Zn<sup>++</sup> ethylene bisdithiocarbamate ion and Manganese ethylene bisdithiocarbamate. There were no significant differences in yield per hectare among the rates of application of all tested fungicides (Table 5).

There were significant differences within the rates of application and within the tested fungicides. The highest rate of application of Piperazin W. 524 gave the highest seed weight and differed from the other treatments. There was no difference in seed weight between the medium rate and the lower rate of application if sprayed with Piperazin W. 524. No differences in seed weight were found among the rates of application in Mn<sup>++</sup>Zn<sup>++</sup> ethylene bisdithiocarbamate ion and also in Manganese ethylene bisdithiocarbamate. Seed weights of the soybean if sprayed with Manganese ethylene bisdithiocarbamate were higher than Mn<sup>++</sup>Zn<sup>++</sup> ethylene bisdithiocarbamate except at the higher rate of application (Table 6).

Piperazin W. 524, Oxycarboxin, Manganese ethylene bisdithiocarbamate and Mn<sup>++</sup>Zn<sup>++</sup> ethylene bisdithiocarbamate ion are promising fungicides for the control of soybean rust. Manganese ethylene bisdithiocarbamate and

$Mn^{++}Zn^{++}$  ethylene bisdithiocarbamate ion probably are promising chemical for practical application under field condition because of their effectiveness. They are cheaper than Piperazin W. 524 and Oxycarboxin. In the present investigations, 3 applications with 5 day intervals of Piperazin gave moderate control and the yield is almost twice of unsprayed or control plot (Table 4). Five applications with 5 day intervals of Piperazin of all rates of application decreased the development of soybean rust and yield increased significantly (Table 5). Manganese ethylene bisdithiocarbamate and  $Mn^{++}Zn^{++}$  ethylene bisdithiocarbamate ion are also gave a good control of soybean rust by using 5 applications with 5 day intervals of 2-1 lb per acre (Table 5, 6). There was no

TABLE 6. Average seed weight of SJI soybean after spraying with 3 fungicides at 3 rates of application compared with unsprayed treatment, all using 5 applications with 5 day intervals

Fungicide	Rate of application lb or ml/acre (Product rate)	Seed weight g/100 seeds
Piperazin W. 524	2,500 ml	12.40 a
	2,000 ml	11.30 b
	1,500 ml	11.15 bc
	Unsprayed	7.30 e
$Mn^{++}Zn^{++}$ ethylene bisdithiocarbamate ion	2.5 lb	10.14 cd
	2.0 lb	9.52 d
	1.5 lb	9.82 d
	Unsprayed	7.04 c
Manganese ethylene bisdithiocarbamate	2.0 lb	10.11 cd
	1.5 lb	10.03 cd
	0.5 lb	10.48 bc
	Unsprayed	7.83 c
		C.V. 7.48%

Any two means followed by the same letter are not significantly different at 5% by Duncan's new multiple range test.

difference between 5 applications and 7 applications with 5 day intervals among all tested fungicides (Table 4). Based on the results obtained from the present investigations the authors would recommend 5 applications with 5 day intervals for soybean rust control using Piperazin, Oxycarboxin, Manganese ethylene bisdithiocarbamate or  $Mn^{++}Zn^{++}$  ethylene bisdithiocarbamate ion.

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