

REPORT ON EXPERIMENTS TO CONTROL CORN DOWNY MILDEW IN THAILAND

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Downy mildew (DM) of corn (*Zea mays* L.) is regarded as a serious disease in several countries in Asia and in some other regions of the world. In Thailand, the disease first reached epidemic proportions in 1968. The disease has apparently occurred in Nakhon Sawan Province on corn for several years prior to the 1968 official report and perhaps in Lop Buri Province as well. It was first seen at Farm Suwan (Thailand's center for corn and sorghum improvement) in Nakhon Rachasima Province in October-November, 1970 and become epidemic there after early season rain in April-May, 1971. Currently it is found in nearly all corn producing areas. Unless it is brought under control this disease may soon be reducing yields by 40% as it has in India (5) the Philippines (3, 8) and Taiwan (1).

In Thailand the fungus closely fits the description of *Sclerospora sorghi* (9). A major proportion of the work done so far by the Department of Agriculture has been on control measures; mainly chemical control and testing for resistant varieties.

Chemical control. — Extensive studies have been conducted by Exconde *et al.* (2, 4) on the use of protectant fungicide. They showed that three spray applications of Duter (20% triphenyl tin hydroxide) at 0.83 lb/100 gal. at 2, 6 and 10 days after emergence and alternate five sprayings with Dithane M-45 (85% zinc manganese ethylene bisdithiocarbamate) at 2 lb/100 gal. at 4, 8, 12, 14 and 16 days after emergence effectively controlled DM. Schultz (6) found that corn seeds treated with Demosan (60% chloroneb) by both slurry and dip application reduced disease incidence up to 2 1/2 weeks after planting even when exposed to high inoculum density. Later, Schultz and Dalmacio (7) obtained successful

sustained control of DM with combination treatment involving seed treatment (methyl cellulose 60 mg 10% Demosan/g seed) plus covering plants for 3 days after emergence plus foliar application (5.0 g 65% wettable Demosan 0.6 ml deep penetrant/l), at 3, 6, 10 and 15 days after emergence.

Three fungicides, Demosan 65 W, Duter, and Dithane M-45 at the active ingredients listed

Table 1. Effect of 12 sprayings with various fungicides on incidence of downy mildew in sweet corn.

Treatment ¹	Disease incidence (%) ²		
	5 days after last spray- ing	10 days after last spray- ing	15 days after last spray- ing
T ₁	S ₀	0.0	0.0
	S ₁	0.0	0.0
T ₂	S ₀	31.3	39.5
	S ₁	22.4	25.4
T ₃	S ₀	32.8	36.3
	S ₁	32.5	35.9
T ₄	S ₀	35.1	35.7
	S ₁	26.9	36.6
T ₅	S ₀	54.4	58.5
	S ₁	46.7	47.0

¹T₁ Demosan 65 W (10.0 g/l).

T₂ Duter (0.08 g/l).

T₃ Dithane M-45 (2.0 g/l).

T₄ Duter alternate with Dithane M-45.

T₅ Check.

S₀ Untreated seed.

S₁ Treated seed with Demosan 65 W (10.0 g/kg seed).

²Mean of three replications.

above, were used in recent studies on chemical control of DM in Thailand. Seeds of sweet corn for the test were divided into two groups. One was treated with Demosan 65 W (10.0 g/kg seed) before sowing and the other was left untreated. The seedlings in the paired plots were sprayed with each of the following fungicides: Demosan 65 W (10.0 g/l), Duter (0.08 g/l), Dithane M-45 (2.0 g/l) and alternatively sprayed with Duter (0.08 g/l) and Dithane M-45 (2.0 g/l). The first application was made 2 days after emergence, followed by seven sprayings at 2 days intervals and four sprayings at 4 days intervals. The results are presented in Table 1. The only successfully sustained control was achieved with; (a) 12 foliar spraying with Demosan 65 W, and (b) seed treatment with Demosan 65 W plus 12 foliar sprayings with Demosan 65 W. Both of these treatments resulted in 100% control for a period of 6 weeks after emergence.

Testing for resistant varieties. — In 1973, 14 maize entries and one susceptible sorghum check were tested for DM resistance at Lamna-

rai, Lop Buri Province and Nakhon Sawan Province. Artificial inoculations with DM were made twice. Spreader rows of the susceptible variety tein were planted around the testing plots 2 weeks earlier and inoculated with DM. The percentage of systemic infection of DM of the test plants was recorded at 2 and 4 weeks after the second inoculation and again at tasselling time. The result at Lamnarai showed that all maize entries become infected; infection ranged from 11.8 to 100% (Table 2). The results obtained from Nakhon Sawan were slightly different with infection ranging from 14.1 to 100% (Table 2).

In 1974, the experiments were carried out only at Nakhon Sawan where two international and one national DM resistant nursery were grown. One of the international nurseries contained 25 entries while the other contained 11 inbred lines plus a sorghum entry. The national nursery contained 10 corn entries. The testing procedure was the same as mentioned above and the results are presented in Tables 3, 4 and 5.

Table 2. Percent infection in the 1973 International Corn Downy Mildew Nursery in provinces in Thailand.

Entry	Number of plants ¹		Percent infection	
	Lamnarai, Lop Buri	Nakhon Sawan	Lamnarai, Lop Buri	Nakhon Sawan
Philippines DMR-3	76	76	12	14
Tainan DMR-2	75	78	24	14
Philippines DMR-1	75	77	25	19
Tainan (CIMMYT) DMR-13	73	75	34	28
Ph.9 DMR	75	77	35	17
Bogor Syn. 2	73	76	38	37
Philippines DMR-2	73	76	41	20
Philippines DMR-4	74	75	43	20
Tainan DMR-4	74	74	49	46
Thai DMR Comp. 3	75	71	51	37
Tainan DMR-10	74	73	55	52
Tainan (CIMMYT) DMR-11	70	74	61	57
PB 5 (Local variety check)	73	78	78	78
Hawaiian super sweet (Susc. check)	64	57	100	100
TSS-18-8 (Susc. sorghum check)	67	66	0	0

¹ Mean of three replications.

Table 3. Percent infection in the 1974 International Corn Downy Mildew Nursery (variety test) at Nakhon Sawan Province, Thailand.

Entry	Number of plants ¹	Percent infection
MIT	104	4
MIT-2	173	5
Phil. DMR 6	127	5
Phil. DMR 3	167	5
Phil. DMR 5	156	10
Phil. DMR 1	140	13
Chain Cross Syn.	167	14
Phil. DMR 2	113	16
Ph.9 DMR (Res. check)	171	17
Tainan DMR 2	176	19
Kretek	176	22
Bogor Comp. 13	168	24
Tainan DMR 1	172	27
G. Kertas	165	30
Bogor Comp. 10	181	31
Thai DMR 7	148	31
Thai Comp. 1 DMR	169	31
No. 853	157	32
Cupurico × Fl. Comp. DMR	180	35
Thai Comp. 3	190	36
Tainan Hybrid 5	135	45
Bogor Syn. 2	176	46
Susc. maize (Local check)	143	71
La Granja Popcorn (Susc. check)	153	84
Tainan Hybrid 5 (Susc. check)	166	87

¹ Mean of four replications.**Table 4.** Percent infection in the 1974 International Corn Downy Mildew Nursery (inbred lines) at Nakhon Sawan Province, Thailand.

Entry	Number of plants ¹	Number of plants infected ¹	Percent infection
Ph. 9 DMR	184	18	10
CM 105-3-3-#-#-3-f-#-#-#	115	10	11
Usatigua F 8-#-#	69	6	13
Narino 330-#-#-6-6-#-2-#-#	169	26	15
Caribbean-Cuba-P. Rico-Guad. × Phil. -2-#-#	180	29	16
Eto-1-#-#	171	40	23
Early Caribbean-4-#-#	162	46	28
Puerto Rico Gr.-1-#-#	162	55	34
Maize variety (Susc. check)	165	90	54
Tx 441	135	83	61
La Granja Popcorn (Susc. check)	151	106	70

¹ Mean of four replications.

Table 5. Percent downy mildew infection of corn varieties in the 1974 test plot of Thailand National Corn and Sorghum Program at Nakhon Sawan Province, Thailand.

Entry	Number of plants ¹	Percent infection
Phil. DMR 5 (S) C ₁	218	6
Phil. DMR 3 (S) C ₁	270	11
Bogor #2 DMR (M) IV	234	27
DMR 1,5 × Thai Comp. #1 BC ³ (S) C ₁	218	28
Thai Comp. #3	233	28
Thai DMR #6	232	29
Tainan #10 DMR (M) II	216	33
Thai Comp. #1 Early × Phil. DMR 1-F ₂	223	37
DMR 1,5 × Cup. Fl. Comp. BC ³ (F) C ₁	209	37
Guatemala PB 11	200	40

¹ Mean of four replications.**Table 6.** Percent downy mildew infection in the 1975 Uniform Station Yield Trial plot at Nakhon Sawan Province, Thailand.

Entry	Number of plants ¹	Percent infection
Thai DMR #6	223	17
Caripeno DMR	226	26
Thai Comp. #3 (S) C ₁	218	27
Bogor #2 DMR (F) I	217	29
Thai Comp. #4	221	34
Thai Comp. #1 DMR (S) C ₂	215	39
Thai DMR #7	205	41
Tainan #10 DMR (F) I	205	52
Comp. F ₁ Comp. DMR (F) C ₂	209	62
GF9	145	100

¹ Mean of four replications.

In 1975, the testing was again made only at Nakhon Sawan. All 10 maize entries became infected and infection ranged from 17.4 to 100% (Table 6). In 1976, 20 corn entries were tested at Nakhon Sawan by the same procedure. Again, all maize entries became infected with a range of 17.5 to 100% (Table 7).

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Table 7. Percent downy mildew infection of corn varieties in the 1976 test plot of Thailand National Corn and Sorghum Program at Nakhon Sawan Province, Thailand.

Entry	Number of plants ¹	Percent infection
Thai Comp. #3 (S) C ₂	206	17
Thai DMR #6	208	23
Caribbean DMR	208	24
Thai Comp. #4	206	26
Comp. L DMR	203	28
Cupurico × Flint Comp. DMR (F) C ₃	207	29
Thai Comp. #1 DMR (S) C ₃	208	30
Caripeno DMR	206	32
Thai DMR #4	186	33
Guatemala DMR	207	33
Thai DMR #2	204	33
Thai DMR #1	208	36
Thai DMR #3	207	41
(Cup. × Fl. Comp. DMR) × Thai Comp. DMR (F) C ₁	208	45
Thai DMR #7	204	48
Centralmex DMR	206	55
Guatemala PB 12	156	79
P. C. 1602	175	83
P. C. 1504	191	93
Sweet Corn Var. H-68	205	100

¹ Mean of two replications.

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