

## 19. REGIONAL ACTIVITIES FOR TESTING MAIZE GERMPLASM

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### Introduction

Downy mildew is one of the most destructive diseases of corn in Asia. The most prevalent species are *Sclerospora philippinensis* in the Philippines, India, and Nepal; *Sclerospora sacchari* in Taiwan, India and the Philippines; *Sclerospora sorghi* in Thailand and India; and *Sclerospora maydis* in Indonesia and India. The disease is considered one of the limiting factors to corn production in Taiwan, Philippines, Indonesia, Thailand and some States in India.

At present, no chemical is known to be able to effectively and economically control the disease. Breeding for resistance to the disease seems to be the only solution.

In 1969, the Inter Asian Corn Program initiated the International Downy Mildew Nursery in order to study the virulence patterns within and among the four main casual *Sclerospora spp.* found in different countries and also to assess the levels of resistance available to country programs that are developing resistant varieties. The results of the international cooperative efforts will be reported in this symposium. It is clear that the relative resistance to the different species in Asian is very similar. The severity of the disease is greatest in the Philippines and least in Taiwan. With these findings, regional cooperative breeding is possible.

Breeding programs have identified resistant varieties. With the cooperative work going in Asia under the Inter Asian Corn Program high yielding populations resistant to downy mildew are identified and recommended in some countries. Taiwan No. 11, a resistant hybrid involving Philippine DMR inbreds is recommended for national distribution in Taiwan. In the Philippines, two high yielding varieties, Philippine DMR 2 (white endosperm) and Philippine DMR 1 (yellow endosperm) both derived from crosses between resistant local varieties and introduced germplasm are being grown extensively in farmers' field. Thailand is using the Philippine DMR's Bogor Syn #2 and Tainan DMR Comp #10 in their breeding program as sources of resistance. Indonesia is multiplying Philippine DMR 3 and Philippine DMR 5 while India will multiply Philippine DMR 1. These countries and others are using high yielding resistant entries from the regional cooperative trials in their breeding programs as sources of resistance.

### Cooperative Program Between Taiwan and the Philippines

During the 1966 Inter Asian Corn Improvement Workshop in India, the breeders agreed to broaden the gene base of resistant germplasm for Southeast Asia. Taiwan was selected to develop a broad composite because of mild virulence and efficient screening technique. In 1967, cooperative effort was begun by the Philippines and Taiwan maize workers with the assistance of CIMMYT and IACP in Thailand. Two broad base composites were developed, Taiwan DMR composite #1 and Taiwan DMR Composite #2.

**Taiwan DMR Composite #1.** Collections from Asia were planted in the nursery and 42 out of 163 inbreds and varieties were chain crossed to develop the Composite.

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This was followed by mass selection in the disease nursery for several seasons. This was included in the International Downy Mildew Nursery in 1969 and found to have good resistance in different countries.

**Taiwan DMR Composite #2.** A set of 92 diverse collections with broad genetic base was sent to Taiwan and the Philippines. The nursery in Taiwan showed infection ranging from 54 to 100 per cent. Most collections had readings greater than 90 per cent. In the Philippines, mean infection ranged from 28% to 83% compared with that of resistant check of 2% and the UPCA VAR's (susceptible checks) of 44%. Disease free plants in Taiwan and the Philippines were self pollinated. Seed from 536 plants was used to grow  $S_1$  progeny tests in Taiwan and the Philippines. Data from the two locations were not highly correlated. Infection in the Philippines was more severe.  $S_1$  lines selected based on downy mildew reaction in Taiwan and the Philippines were bulk pollinated to form the Taiwan DMR Composite #2. The composite has been random mated for several generations with some selection for resistance and it showed moderate resistance to downy mildew.

### **Inter Asia Corn Program Downy Mildew Yield Trial**

The programs in the Philippines and Taiwan are much more advanced in breeding for resistance to downy mildew. Several resistant varieties and composites were developed in both programs. The Inter Asian Corn Program initiated in 1971 a regional testing of downy mildew resistant selections. The main objective of the cooperative efforts was to look for well adapted downy mildew resistant populations with acceptable yield and desirable agronomic characteristics. The cooperating countries involved were India, Thailand, Indonesia, Nepal, Mexico, Taiwan and the Philippines.

The trial consisted of 11 downy mildew resistant varieties and composites plus a check which varied from country to country. The same entries were tested in 1971 and 1972 except Bogor Syn #2 which replaced Tainan DMR Composite #4 in one location (Thailand). Six entries came from the Philippines (Philippine DMR's 1, 2, 3, 4, 5 and 6) five from Taiwan (Tainan DMR Comp #1, 2, 4, 10 and 12) and one from Indonesia, Bogor Syn #2. The pedigrees are shown below:

<b>Designated Name</b>	<b>Derived From</b>
<b>Entries from the Philippines</b>	
1. Philippine DMR 1	MIT VAR 2×Cuba Gpo. 1 (yellow)
2. Philippine DMR 2	College White×Tuxpeno (white)
3. Philippine DMR 3	MIT VAR 2×Flint Comp. Amar. (yellow)
4. Philippine DMR 4	MIT VAR 2×Flint Comp. Amar. (white)
5. Philippine DMR 5	MIT VAR 2×Cupurico (yellow)
6. Philippine DMR 6	Eto Blanco×Aroman WF (white)
<b>Entries from Taiwan</b>	
1. Tainan DMR Comp. #1	Ph9 DMR, A117, 2026-7, 2028-2, AME III, 2015-7, PF 202, EG 200, Tw 86, 1069-2, Tw 62, 2027-3-5, 2027-4-1, 2029-8-1, 2029-8-4, 2031-6-1, 2126-3-4, 2039-9-1-3, 2074-2, 2075-2-1-4, 2050-4-3-1, 2053-4-3
2. Tainan DMR Comp. #2	EG 200, EG 202, EG 203, Ph9, Ph7, A117, College White×Tuxpeno, MIT Selection, Aroman White Flint, Kabacan White Flint, Bicol White Flint, Tiniguib White Flint, Cebu White Flint, Cebu White Flint (B), Bukidnon White Flint, Cadlan White Flint

3. Tainan DMR Comp. #4 L. Y 4-2-1, L. Y 4-2-3, L. Y 8-1-2, L. Y 8-1-2,  
L. Y 8-1-2, L. Y 8-1-2, L. Y 8-1-2, L. Y 8-1-2,  
L. Y 8-1-3, L. Y 8-1-3, L. Y 9-1-2, L. Y 10-1-1,  
L. Y 17-1-1, L. Y 17-1-1, L. Y 17-1-3, L. Y 17-1-3,  
L. Y 17-1-3, L. Y 17-1-4, L. Y 17-1-4, L. Y 17-1-4,  
L. Y 17-1-4, L. Y 17-1-4, L. Y 17-1-4, L. Y 17-1-4,  
L. Y 17-1-4, L. Y 17-1-5, L. Y 17-3-1, L. Y 17-3-1,  
L. Y 17-3-1, L. Y 17-3-1, L. Y 17-3-1, L. Y 17-3-2,  
L. Y 17-3-2, L. Y 17-3-2, L. Y 17-3-2, L. Y 17-3-3
4. Tainan DMR Comp. #10 Bogor Syn #1, Bogor Syn #2, Pendjainan, Wonosobo  
Composite, Bogor Comp. 1, Bogor Comp. 2, Bogor  
Syn #2, Bogor Syn #3, Bogor Comp. 4, Bogor  
Comp. 5
5. Tainan DMR Comp. #12 High Lysine Composite

The test materials were prepared at the University of the Philippines at Los Baños, College of Agriculture and sent to the cooperating countries. Included in the shipments were the planting plan, data sheets and instruction in conducting the trial. The instruction was provided to ensure uniform gathering of data.

Philippine DMR 2, a recommended variety in the Philippines was the best yielder in the Philippines followed by Tainan DMR Comp. #10 (Table 1) while in India, Tainan DMR Comp. #10 gave the highest average yield followed by the check (Table 2). Guatemala PB5, a check variety, outyielded the downy mildew resistant entries in Thailand (Table 3). In Indonesia, Tainan DMR Comp. #10 gave the highest yield while Philippine DMR 4 rank second (Table 4). There was only one location and one year test in Taiwan. Taiwan No. 11, a resistant hybrid check, gave the highest yield followed by Tainan DMR Comp. #10. The Philippine DMR's were better than the other Tainan DMR's.

**Table 1. Grain yield in kilograms per hectare of downy mildew resistant varieties evaluated in the Philippines in 1971 and 1972.**

Rank	Pedigree	Cotabato	Isabela	UPCA	Mean
1	Philippine DMR 2	2,621	2,457	5,068	3,388
2	Tainan DMR Comp. #10	2,867	2,951	4,329	3,382
3	Philippine DMR 4	2,744	2,072	4,665	3,160
4	Check	2,744	2,481	4,082	3,102
5	Philippine DMR 3	2,369	2,436	4,407	3,071
6	Philippine DMR 5	2,122	3,058	3,948	3,043
7	Philippine DMR 1	1,994	2,430	4,525	2,983
8	Philippine DMR 6	2,246	2,033	4,334	2,874
9	Tainan DMR Comp. #1	2,122	1,538	3,763	2,474
10	Tainan DMR Comp. #4	1,870	1,854	3,466	2,397
11	Tainan DMR Comp. #2	1,747	1,753	3,578	2,359
12	Tainan DMR Comp. #12	1,372	1,719	3,422	2,171
	C. V. (%)	19.9	15.0	11.7	
	L. S. D. 0.5	706	493	694	
	Check	MIT DMR 2	Philippine Sweet Synthetic #1	Aroman	

**Table 2. Grain yield in kilograms per hectare of downy mildew resistant varieties evaluated in India in 1971 and 1972**

Rank	Pedigree	Udaipur (1971)	Udaipur (1972)	Ludhiana (1971)	Ludhiana (1972)	Pantnagar (1971)	Pantnagar (1972)	Mean
1	Tainan DMR #10	4,831	2,866	6,863	2,034	2,687	3,452	3,789
2	Check	4,683	2,439	6,047	2,531	2,333	4,026	3,677
3	Philippine DMR 4	4,435	1,946	5,898	1,906	2,393	3,466	3,341
4	Tainan DMR Comp. #4	3,784	—	3,937	—	1,807	—	3,176
5	Philippine DMR 2	3,522	2,239	5,145	1,490	2,767	2,413	2,929
6	Philippine DMR 5	3,259	2,119	4,683	1,590	2,520	3,093	2,877
7	Tainan DMR Comp. #2	3,576	1,733	4,753	1,914	2,308	2,866	2,858
8	Tainan DMR Comp. #1	4,165	1,812	4,926	2,203	1,853	3,119	2,704
9	Philippine DMR 1	3,204	2,266	3,671	1,986	2,160	2,746	2,672
10	Philippine DMR 6	4,208	2,346	5,051	1,356	2,733	3,346	2,616
11	Philippine DMR 3	3,333	2,559	4,910	1,453	2,607	3,719	2,477
12	Tainan DMR Comp. #12	3,008	2,533	2,824	1,168	1,280	3,546	2,393
	C. V.	20.0	8.0	20.4	14.6	—	22.0	
	L. S. D. 0.5	1,461	369	1,461	—	—	213	
	Check		Jawahar Comp.		Jawahar Comp.	Ganga-2		

**Table 3. Grain yield in kilograms per hectare of downy mildew resistant varieties evaluated in Thailand in 1971 and 1972.**

Rank	Pedigree	Farm Swan (1971)	Farm Swan (1972)	Mean
1	Check	4,502	5,577	5,040
2	Philippine DMR 4	4,769	4,833	4,801
3	Philippine DMR 3	4,775	4,618	4,697
4	Philippine DMR 6	4,486	4,686	4,586
5	Philippine DMR 5	4,253	4,881	4,567
6	Philippine DMR 2	4,332	4,787	4,560
7	Tainan DMR Comp. #10	4,291	4,463	4,377
8	Philippine DMR 1	3,426	4,487	3,957
9	Tainan DMR Comp. #2	3,648	3,915	3,782
10	Tainan DMR Comp. #1	3,252	3,372	3,312
11	Tainan DMR Comp. #12	2,839	2,832	2,836
12	Tainan DMR Comp. #4	2,398	—	2,398
	C. V. (%)	8.5	8.6	
	L. S. D. 0.5	496	467	
	Check	Guatemala PB5	Guatemala PB5	

The top yielder over all locations in two years was Tainan DMR Comp. #10 with mean yield of 3814 kg/ha and 3868 kg/ha in 1971 and 1972, respectively (Table 5). Among the Philippine DMR's Philippine DMR 4 was the best with an average of 3555 kg/ha and 3725 kg/ha in 1971 and 1972, respectively. This was followed by Philippine DMR

**Table 4. Grain yield (kg/hectare) of downy mildew resistant varieties grown in Indonesia in 1971 and 1972**

Rank	Pedigree	Bogor	Bontobili Sulawesi	Bogor	Citayam	Mean
1	Tainan DMR Comp. #10	1,992	3,251	6,062	5,663	4,242
2	Philippine DMR 2	2,251	2,805	5,566	5,233	3,946
3	Philippine DMR 4	2,200	3,093	5,533	5,010	3,959
4	Philippine DMR 3	2,235	3,287	4,967	4,597	3,772
5	Philippine DMR 6	1,694	2,531	5,549	5,150	3,731
6	Philippine DMR 1	1,945	2,659	5,086	4,660	3,588
7	Check	1,940	1,538	5,538	5,193	3,552
8	Philippine DMR 5	1,887	2,108	4,721	4,210	3,232
9	Tainan DMR Comp. #1	1,538	2,103	4,502	4,209	3,088
10	Tainan DMR Comp. #2	1,663	2,564	3,998	3,780	3,001
11	Tainan DMR Comp. #4	1,220	1,831	3,882	3,683	2,654
12	Tainan DMR Comp. #12	1,239	1,397	3,784	3,573	2,498
	C. V. (%)	16	22.9	8.1	8.1	
	L. S. D. 0.1	444	—	—	270	
	Check	Harapan	Local Variety	Harapan	Harapan	

**Table 5. Summary grain yield in kilograms per hectare and days to silking of downy mildew resistant varieties included in IACP DMR Trial for 1971 and 1972**

Entry	1971 <sup>1)</sup> grain yield	Days to silk	1972 <sup>2)</sup> grain yield	Days to silk
Tainan DMR Comp. #10	3,814	60	3,868	54
Philippine DMR 4	3,555	59	3,725	55
Philippine DMR 3	3,390	61	3,621	55
Philippine DMR 2	3,387	61	3,594	55
Philippine DMR 6	3,221	61	3,603	54
Philippine DMR 5	3,122	64	3,392	55
Philippine DMR 1	2,758	59	3,516	52
Tainan DMR Comp. #1	2,814	53	3,128	49
Tainan DMR Comp. #2	2,810	55	3,001	50
Tainan DMR Comp. #4	2,512	54	—	48
Check	3,472	59	4,032	53
Tainan DMR Comp. #12	2,072	52	3,214	47

1) Mean of 9 locations.

2) Mean of 6 locations.

varieties 3, 2, 6, 5. The rest of the Tainan DMR Composites occupy the lower ranks with Philippine DMR 1.

In general, Tainan DMR Comp. #10 and Philippine DMR's flowered later than the rest of the Tainan DMR's. Philippine DMR 1 was the earliest to flower among the Philippine DMR's which was comparable with the maturity of the Tainan DMR's. The Philippine

**Table 6. Summary percent downy mildew infection of resistant varieties grown under normal conditions**

Rank	Entry	Indonesia Bogor	Philippines Bukidnon	Taiwan Potzu	Thailand Farm Swan	India Pantnagar	Mean
1	Philippine DMR 5	14	9	1	2	0	5
2	Philippine DMR 3	25	5	3	2	0	7
3	Philippine DMR 2	30	9	1	2	0	8
4	Philippine DMR 4	35	8	2	2	0	9
5	Tainan DMR Comp. #2	31	4	1	7	0	9
6	Philippine DMR 6	42	4	3	2	0	10
7	Philippine DMR 1	39	6	3	6	0	11
8	Tainan DMR Comp. #1	46	19	4	7	2	15
9	Tainan DMR Comp. #4	55	24	5	11	—	19
10	Tainan DMR Comp. #12	70	36	13	12	7	28
11	Tainan DMR Comp. #10	69	36	26	13	8	30
12	Check	94	25	12	4	33	34
	Check	Harapan	UPCA VAR 2	Taiwan No. 11	Guatemala PB5	Ganga 5	

DMR's and Tainan Comp. #10 were likewise taller.

Summary percent downy mildew infection is shown in Table 6. Other locations with insignificant downy mildew readings were not included. The infection occurred under natural conditions. The extent of downy mildew infection was relatively low in all locations. The Philippine DMR varieties demonstrated better degree of resistance than the Taiwan DMR Composites except Tainan DMR Comp. #2. Tainan DMR Comp. #10 which was the top yielder showed the highest infection among the resistant entries with 30 percent.

In 1974, we dropped in the trial Philippine DMR varieties 1, 5, and 6, Tainan DMR

**Table 7. Grain yield in kilograms per hectare of downy mildew resistant varieties included in IACP DMR trial for 1974 in UPLB, Philippines, Farm Suwan, Thailand, Poza Rica, Mexico and Nepal**

Rank	Entry	Philippines	Thailand	Mexico	Nepal	Mean
1	Tainan DMR Comp. #10	7,409	4,060	2,180	3,964	4,403
2	Thai DMR Comp. #1	6,115	4,326	3,207	3,047	4,174
3	Philippine DMR 2	5,869	4,829	2,872	3,060	4,157
4	Philippine DMR 4	4,855	5,335	2,722	2,794	3,926
5	CIMMYT-Taiwan DMR Comp. #13	6,143	4,035	1,829	3,463	3,868
6	Philippine DMR 8	5,443	4,866	2,665	2,259	3,808
7	Local Check	4,726	1,821	3,934	3,390	3,468
8	Philippine DMR 3	3,858	4,191	2,352	2,613	3,254
9	CIMMYT-Taiwan DMR Comp. #11	4,721	1,868	1,817	2,778	2,796
10	Taiwan-Indonesia DMR Comp. #1	2,005	2,184	1,377	2,410	1,994
	Local Check	Phil. DMR 1	Guatemala	Tuxpeno	Rampur yellow	
	C. V. (%)	25.5	10.5	20.6	22.2	

Comp. 1, 2, 4, and 12. We included new entries, Philippine DMR 8, from the Philippines; CIMMYT-Taiwan DMR Composite #11, 13, Taiwan-Indonesia DMR Comp. #1 from Thailand. This time the trial consisted of 9 resistant entries and a local check.

Tainan DMR Comp. #10 was the top yielder in the Philippines and Nepal with 7,409 kg/ha and 3,964 kg/ha, respectively (Table 7). In Thailand, Philippine DMR 4 gave the highest yield with 5,335 kg/ha while in Mexico, Tuxpeño, a local check, out yielded the resistant entries. Over all locations Tainan DMR Comp. #10 gave the highest mean yield.

As in previous trials the Philippine DMR varieties showed better resistance than Taiwan and Thailand entries (Table 8). Data from the IACP International Downy Mildew Nursery grown under epiphytotic conditions also showed that the Philippine DMR entries are more resistant than the Taiwan and Thailand entries (Table 9). Percent

**Table 8. Percent downy mildew infection of resistant varieties included in IACP trial in 1973, UPLB, Philippines and Farm Suwan, Thailand**

Rank	Entry	Philippines	Thailand	Mean
1	Philippine DMR 3	2	10	6
2	Philippine DMR 2	10	6	8
3	Philippine DMR 4	13	2	8
4	Philippine DMR 8	18	9	14
5	CIMMYT-Taiwan DMR Comp. #13	29	16	23
6	Tainan DMR Comp. #10	24	25	25
7	Thai DMR Comp. #1	28	25	27
8	Taiwan Indonesia DMR Comp. #1	35	29	32
9	CIMMYT-Taiwan DMR Comp. #11	23	42	33
10	Local Check	15	55	35
	Local Check	Philippine DMR 1	Guatemala	

**Table 9. Percent plants infected with downy mildew grown in 1971 IACP International Downy Mildew Nursery**

Rank	Entry	Thailand			Taiwan Potzu	Phil. Musuan	Indonesia Bogor	Mean
		Naborn Sawon	Chaibadan	Farm Swan				
1	Philippine DMR 3	15	12	22	3	6	44	17
2	Philippine DMR 4	20	43	31	0	10	43	25
3	Philippine DMR 2	20	41	42	0	10	44	26
4	CIMMYT-Taiwan DMR Comp. #13	28	34	57	1	21	45	31
5	Thai DMR Comp. #1	37	51	71	1	20	76	43
6	CIMMYT-Taiwan DMR Comp. #11	57	61	83	10	7	65	47
7	Taina DMR Comp. #10	52	55	68	13	26	77	49
8	Local Chec (Susceptible)	78	78	92	81	22	84	73
9	Hawaiian Supersweet	100	100	99	40	69	97	84

infection varies from location to location but ranking is highly correlated.

During the 9th Inter Asian Corn Workshop the group decided to merge the downy mildew yield trial and the Inter Asian yield trial #2. Entries will be sent to Bangkok.

### Regional Cooperative Breeding

In 1972, the Inter Asian Corn Program, initiated a regional breeding program to develop resistant varieties adapted in the region and to provide national breeding programs with lines or varieties they can use in their program as source of resistance. The cooperators are Thailand, Indonesia, Taiwan and the Philippines. The group decided to use Caribbean DMR Composite developed in the Philippines as the base population and Taiwan will produce the  $S_1$  lines.

The Caribbean DMR Composite was developed by crossing Caribbean Composite from CIMMYT, a composite of varieties from the Caribbean, with resistant Philippine inbreds

**Table 10. Yield Frequency distribution of Caribbean DMR  $S_1$  lines**

Interval (kg/ha)	Frequency Distribution		
	Philippine	Taiwan	Thailand
1,001-1,250	0	1	0
1,251-1,500	0	2	0
1,501-1,750	1	6	1
1,751-2,000	1	13	2
2,001-2,500	1	13	2
2,501-2,750	12	16	5
2,751-3,000	13	31	7
3,001-3,250	13	30	16
3,251-3,500	37	35	21
3,501-3,750	26	23	24
3,751-4,000	26	28	27
4,001-4,250	24	29	35
4,251-4,500	14	21	35
4,501-4,750	12	12	34
4,751-5,000	15	13	27
5,001-5,250	6	11	32
5,251-5,500	14	10	22
5,501-5,750	4	8	17
5,751-6,000	2	5	6
6,001-6,250	4	4	10
6,251-6,500	2	3	6
6,501-6,750	0	4	1
6,751-7,000	0	0	2
7,001-7,250	0	2	0
7,251-7,500	0	1	1
7,501-7,750	0	1	0
Total	229	338	338
Overall mean yield (kg/ha)	3,894	3,696	4,030



and varieties, Ph9 DMR, Mimies, MIT VAR, 2, Aroman 206, Tiniguib, and Aroman White Flint. The F<sub>1</sub>'s were intercrossed. Equal amount of seeds from each cross were bulked and advanced for three generations in the breeding nursery without selecting for downy mildew resistance. The Composite was then planted in an isolated plot (3,000 sq meters) in the downy mildew nursery in Musuan, Bukidnon. Infection was about 6%. The survivors were sibpollinated by bulking pollen from one row and pollinating the next row. Equal amount of seed from each pollinated ear was bulked and the derived population was called Caribbean DMR Composite.

The base population was planted in Potzu, Taiwan and downy mildew free plants were self-pollinated. The S<sub>1</sub> lines were grown for downy mildew reaction and yield in Taiwan and yield in the Philippines, Thailand and Indonesia.

A total of 338 S<sub>1</sub> lines were evaluated in Taiwan and Thailand. In the Philippines and Indonesia only 229 and 143 S<sub>1</sub> lines, respectively were tested. Indonesia reported only downy mildew reaction.

Grain yield in the Philippines ranged from 1571 kg/ha to 6320 kg/ha with mean of 3894 kg/ha. In Taiwan, the lowest yield was 1035 kg/ha and the highest 7635 kg/ha while in Thailand it ranged from 1830 kg/ha to 7266 kg/ha. Highest overall mean of all progenies were obtained from Thailand with 4431 kg/ha and lowest in Taiwan with 3696 kg/ha. The yield frequency distribution is shown in Table 10.

Downy mildew infection was relatively low (Table 11). The mean of all progenies was 13.8 percent in Taiwan (338 S<sub>1</sub> lines) and 11.5 percent in Indonesia (143 S<sub>1</sub> lines). Forty one S<sub>1</sub> lines in Taiwan and seventeen S<sub>1</sub> lines in Indonesia showed no infection. In Taiwan 49% of all progenies showed 10% or less infection and in Taiwan 57%.

Forty S<sub>1</sub> lines based upon yield and disease performance at all locations were selected

**Table 11. Percent downy mildew infection frequency  
distribution of Caribbean DMR S<sub>1</sub> lines**

Interval (Per cent)	Indonesia	Taiwan
0	17	41
1- 5	33	65
6-10	32	61
11-15	25	42
16-20	10	48
21-25	10	25
26-30	6	20
31-35	3	13
36-40	5	11
41-45	1	7
46-50	0	0
51-55	0	0
56-60	0	1
61-65	1	2
66-70	0	1
71-75	0	0
76-80	0	1
Total	143	338
Mean all progenies	11.5	13.8

**Table 12. Mean yield and downy mildew infection of selected S<sub>1</sub> lines**

Entry	Yield (kg/ha)			Average	Downy mildew infection (%)	
	Philippines	Taiwan	Thailand		(1973)	(1974)
6	5,401	4,800	6,317	5,506	12	6
11	4,780	5,026	5,410	5,072	0	0
13	5,653	7,635	6,353	6,547	7	15
25	4,998	4,767	7,266	5,677	0	14
45	5,995	4,492	5,394	5,294	20	12
48	6,062	4,354	5,070	5,162	29	18
57	5,415	6,040	5,850	5,768	10	19
58	5,158	4,373	6,917	5,483	32	5
67	4,262	3,869	4,995	4,375	3	7
70	6,121	4,052	5,248	5,140	30	11
80	4,312	5,535	6,200	5,349	17	20
93	4,841	5,327	5,602	5,257	11	17
97	4,175	5,017	5,941	5,044	23	4
98	5,460	5,235	4,724	5,140	9	0
108	5,396	5,902	5,680	5,659	17	18
118	6,221	5,967	5,576	5,921	9	8
119	4,651	4,912	5,435	4,990	5	4
123	4,628	6,151	5,250	5,343	10	20
139	—	4,008	6,435	6,731	24	3
148	5,779	5,248	5,562	5,530	20	13
154	5,737	5,042	6,006	5,595	2	0
156	5,634	6,596	6,198	6,143	3	6
166	5,127	7,370	5,831	6,109	0	4
180	5,477	5,721	5,393	5,530	3	4
182	—	4,433	5,647	5,040	9	0
187	3,293	6,387	6,228	5,303	25	13
190	—	7,163	5,526	6,344	10	4
201	6,269	4,060	4,936	5,088	7	7
227	—	5,797	4,791	5,294	0	0
237	—	5,927	4,643	5,285	8	14
245	—	6,573	4,429	5,501	11	19
258	—	4,559	4,587	4,573	9	0
261	4,754	5,214	3,747	4,572	0	0
276	—	5,747	5,360	5,554	0	4
286	—	6,322	6,226	6,274	16	17
289	—	5,318	4,684	5,051	7	0
297	5,233	5,369	3,067	4,736	4	20
307	—	4,567	4,888	4,628	6	10
328	—	4,246	4,691	4,468	6	0
333	—	5,332	5,656	5,494	3	0
Mean Selected S <sub>1</sub> lines	5,216	5,436	5,460	5,392	10.4	8.4
Mean all progenies	3,894	3,696	4,427	4,030	13.8	—

(Table 12). The mean of selected lines was 5392 kg/ha compared to the overall progeny means of 4030 kg/ha. Percent infection was only 10.4. When the selected lines were grown in the nursery for compositing, percent infection was 8.4 percent while that of the susceptible check (Taiwan No. 5) was 95 percent.

The forty  $S_1$  lines were chain-crossed in Taiwan in fall 1973. In Spring 1974, a cycle of random mating simulated by bulk pollinations was carried out in Taiwan. Bulk seeds will then be sent to Thailand, Philippines and Indonesia for evaluation and use in their local breeding programs. Final plan for recurrent selection on a regional basis in this population and other populations will be made at this Symposium.

### Cooperators

The regional cooperative testing is possible because of the full cooperation of maize workers in the region. The following are the cooperators:

Taiwan	— Mr. S. C. Chang
Thailand	— Dr. Sujin Jinahyon Mr. Ampol Senanarong Dr. Charles Moore
Mexico	— Dr. Ernest Sprague — Dr. Carlos de Leon
Nepal	— Dr. Melvin Splitter Mr. Gopal Rajbhandary
Indonesia	— Dr. Rusli Hakim
India	— Dr. Joginder Singh Dr. V. L. Asnani
Philippines	— Dr. Virgilio R. Carangal Dr. Bliss Aday

### Question and Answer

**Joginder Singh, India:** Phil DMR as well as local check varieties have shown high yield rates in the Downy Mildew Yield Trials of IACP, and high marks for disease reaction. Do you think that there is a negative association between yield and resistance?

**Answer:** Definitely no. I think what you really want to know is what we should do next after obtaining high yielding downy mildew resistant varieties. Looking at the data presented by breeders from the Philippines, Thailand and India, there are good selections better than the Philippine DMRs. I would say that the identification of these varieties in the IACP trials was just the beginning.

**K. M. Safeulla, India (Comment):** In Mysore (India) Phil. DMR 1 and Phil. DMR 5 were found to be highly resistant under field conditions. I can show a couple of slides if I am permitted to do so.

**Answer:** Please show your slides.

**D. M. Tantera, Indonesia:** In the selection process to get DMR varieties, especially from the local early maturing varieties, you tend to lose the early maturing character. Is this generally true? If so, could you give the reason?

**Answer:** Yes, because the breeders normally select for yield and disease resistance. Since the early maturing character is associated with the low yielding variety chances are that early maturity will be lost. However, if you closely select for early maturity, high yield and disease resistance, it is possible to develop early maturing varieties with high yields and resistance to downy mildew.

**K. M. Safeulla, India:** Since resistant germ plasm has been found both in sorghum and maize, I feel there is an immediate necessity to have a resistant gene

pool for use in different maize and sorghum growing countries. What are your views about it?

**Answer:** I agree with you. We have already started developing a resistant germ plasm pool for corn in the region. There are now several gene pools in each breeding program particularly in Thailand, India and the Philippines. For sorghum, I do not know if there are any. Maybe somebody wants to make some comments.