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INCIDENCE OF FALSE SMUT DISEASE OF RICE IN RELATION TO RICE VARIETY AND CLIMATIC FACTORS IN MALAYSIA

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RINGKASAN

Dalam penjangkitan penyakit barteh padi dari musim ke musim faktor-faktor iklim memainkan peranan penting dan bukan bahan-bahan tanaman yang digunakan.

Faktor-faktor ilkim ini adalah suhu, hujan dan tempuh cahaya matahari. Suhu yang rendah, hujan yang banyak dan tempuh cahaya matahari yang singkat boleh mendatangkan dan menambahkan keterokan penyakit barteh di dalam bendang. Ini didapati berlaku di dalam luar musim sahaja.

Ketahanan kepada penyakit barteh boleh didapati pada tujuhbelas jenis padi yang dikaji. Walaupun sa bilangan kecil jenis-jenis padi mempunyai ketahanan penyakit yang sama di dalam dua luar musim berturut-turut, kebanyakannya berubah kepada kiraan penyakit yang lebih tinggi. Ini disebabkan oleh pengaruh faktor-faktor iklim tersebut di atas, yang lebih sesuai dalam luar musim kedua.

INTRODUCTION

The false smut disease of rice caused by *Ustilaginoidia virens* (Cke) Tak, has been reported to occur in Peninsular Malaysia (formerly Malaya) by JOHNSTON (1958). The disease could have occurred earlier, but was probably not reported. It is also present in most of the major rice growing areas of the world (OU, 1972). OU (1972) also reported that it caused little damage except under special conditions, and that high rainfall or high humidity was particularly favourrable for the growth of the pathogen.

In Malaysia, it has been observed to occur sporadically with intensities which differ from season to season. While false smut disease varies in its effects on different varieties, the author feels that weather conditions also play a vital role in the initiation and intensity of infection and, accordingly, has attempted to identify the major climatic factors which favour infection. The author has also investigated whether seeds collected from severely infected crops could be used without causing disease in the next crop.

MATERIALS AND METHODS

Experiment 1: Carry over of the False Smut Pathogen from Season to Season

(A) During the 1977 off season's crop, rice variety, Improved Mahsuri planted in the Department of Agriculture field at Bumbong Lima was observed to be severely infected with false smut pathogen. Disease was assessed on the scale developed for false smut *(Table 1)*. The crop was found to be uniformly infected with an average score of 6.5 *(Table 2)*. This means an average of four to five infected grains per panicle.

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Seeds of Improved Mahsuri from this crop were collected and treated as follows:–

T1 – Seeds were harvested, cleaned, winnowed and subjected to normal sun-drying to 14% moisture content *(the normal process)*.

T2 – Seeds were harvested from *non-infected panicles only* and subjected to normal sundring to 14% moisture content.

T3 – Seeds were harvested from *infected panicles only* and subjected to normal sundrying to 14% moisture content.

T4 – Seeds as T1 were *seed-dressed with fungicide ceresan* at 2g/100g of seeds.

T5 – Seeds as T1 were *subjected to hot water treatment* at 53°C for 15 minutes.

Seeds of these treatment were sown in the nursery in the normal way and twenty five days later seedlings were transplanted, two per hill, in 5x5m plots at a planting distance of 25x25cm. The experiment was conducted in a randomised complete block design with four replicates.

The plants were scored for false smut at the ripened stage according to the scale given in *Table 1*. Scoring was done on five tillers per hill and twenty hills per treatment plot, giving a total of 100 tillers assessed per treatment plot.

(B) Seeds from the various treatments in Experiment 1A were harvested separately and subject to the normal process as in T1 above. Then they were sown in the nursery and seedlings were planted as in Experiment 1A. The plants were scored for false smut at the ripened stage as in Experiment 1A.

TABLE 1. DISEASE SCALE FOR ASSESSING VARIETAL RESISTANCE TO FALSE SMUT OF RICE UNDERNATURAL INFECTION

Disease Score	Assessment Criteria: Observed average* No. of Infected Spikelet/Panicle	Assessment Criteria: Calculated % Spikelet Infected	Disease Reaction
0	0	0	Immune (Im)
1	<¼	0.1%	Very Resistant (VR)
2	>¼	0.1–0.4%	Resistant (R)
3	½	0.5–0.9%	Moderately Resistant (MR)
4	1½	1.0–1.4%	High Intermediate (HI)
5	3	1.5–1.9%	Intermediate (I)
6	4	2.0–2.4%	Low Intermediate (LI)
7	5	2.5–2.9%	Moderately Susceptible (MS)
8	6	3.0–4.0%	Susceptible (S)
9	>7	5%	Very Susceptible (VS)

* Average of 5 observed panicles per hill approximately at 1% sample size for natural infection in the field and 10% sample size for screening plots.

NB: Assessment done at ripened stage.

Experiment 2: Effects of Rice Variety and Climatic Factors on False Smut Disease.

Seventeen varieties were planted successively for three season, the off season 1977, main season 1977/78 and the off season 1978, in plots of 5x4 hills at a planting distance of 25x25cm. A total of 90 kg of nitrogen, 45 kg of P205 and 35 kg of K2O per hectare were broadcast as fertilizers during their growth. Disease observation commenced at milk filling stage and the plants were scored for disease at the ripened stage by the scale in *Table 1*. A sample of 10% of the total number of tillers were randomly taken for the assessment.

RESULTS AND DISCUSSION

1. Carry over the pathogen from season to season

Despite severe infection of variety Improved Mahsuri during the off season's (1977) cropping, no disease was observed in the following season (main season 77/78), in any of the Bumbong Lima field areas. This was also true when seeds from the same severely infected plants of the 1977 off season's crop were used for the main season 77/78 crop *(Table 2)*. Even when seeds of the same severely infected plants of the 1977 season, as in treatments T1 and T3 were used there was no disease during the main season 77/78 *(Table 2)*. Thus control measures as in treatments T2, T4 and T5 could not be assessed. However, plants grown from seeds of all these treatments collected from the main season 77/78 experiment showed definite natural infection with disease scores ranging from 6 to 8 *(Table 2)*, when planted out during off season 1978.

The results indicate that the disease is prevalent mainly in off season crops and that seasonal climatic factors are important in false smut. Therefore, seeds collected from infected crops may safely be used as planting materials in the next season.

TABLE 2. EFFECT OF VARIOUS TREATMENTS ON THE CARRYOVER OF FALSE SMUT OF RICE (1977–1978) ON RICE VARIETY IMPROVED MAHSURI

	Average[a] Disease Score[b]		
Treatment	Off Season 77	Main Season 77/78	Off Season 78
T1[c]	6.5[d]	0	8
T2	–	0	7
T3	–	0	7
T4	–	0	8
T5	–	0	6

a – Average of four replicates with a total of 400 panicles assessed at random.
b – See *Table 1*.
c – This treatment is the normal process practised by farmers and serves as the 'control'.
d – This is the average disease score obtained by sampling four plots of Improved Mahsuri from a field uniformly infected with false smut. This gave a total of 400 panicles randomly sampled for disease assessment.

Table 3 shows that there is varietal resistant against false smut. Even within a single season conducive to the disease (off season 1977), disease varied from 0 to 6.5 i.e. from "immune" to "moderately susceptible" in different varieties. This was true again in the off season 1978 which was also conducive to the disease.

However, certain varieties such as Ria, Bahagia, Masria and MR7 remained disease free in three successive seasons. It is interesting to note changes in resistance of some varieties from one conducive season (off season 1977) to the next (off season 1978). Thus Malinja which had zero (0) disease in off season 1977 had a rating of 3 in off season 1978; and Mahsuri which was "resistant" at the score of 2 became of "intermediate resistance" with a score of 6 in off season 1978. This again strongly indicates that changes in climatic factors from season to season greatly affect the resistance of some varieties.

3. Effect of climatic factors on disease

False smut in the seventeen varieties in the three season was studied in relation to (i) temperature (ii) rainfall and (iii) sunshine *(Table 4)*, particularly in relation to infection and

TABLE 3. DISEASE RATINGS OF 17 RICE VARIETIES TO FALSE SMUT FOR THREE SEASONS AT BUMBONG LIMA (1977–1978)

Variety	Disease Score[a]		
	Off Season 1977	Main Season 1977/78	Off Season 1978
1. Malinja	0	0	3.0
2. Mahsuri	2.0	0	5.5
3. Ria	0	0	0
4. Bahagia	0	0	0
5. Masria	0	0	0
6. Murni	1.5	0	4.5
7. Jaya	3.0	0	0
8. SMI	3.5	0	4.5
9. SMI I	4.0	0	6.5
10. PM I	6.5	0	9.0
11. MR I	3.0	0	3.5
12. MR 7	0	0	0
13. MR 17	1.0	0	4.0
14. Mat Candu	1.0	0	3.0
15. Sri Sekinchan	3.0	0	8.5
16. IR8/Eng. Sac.	4.0	0	7.5
17. Improved Mahsuri	6.5	0	7.0
Average for 17 varieties	2.3	0	3.9

a – See *Table 1* for disease reactions.

TABLE 4. AVERAGE MONTHLY TEMPERATURE, RAINFALL AND SUNSHINE FOR THREE SEASONS AT BUMBONG LIMA (1977–1978)

Year \ Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (°C)												
1977				32.8	31.7	31.5	31.9	31.5	31.0	31.3	31.4	31.7
1978	31.9	33.1	32.9	32.7	32.2	30.9	30.6					
Rainfall (mm)												
1977				7.5	18.6	6.4	0.7	10.4	10.9	15.9	8.5	1.9
1978	2.0	1.4	1.4	5.0	13.0	13.2	4.2					
Sunshine Hours												
1977				8.4	7.9	7.3	7.1	5.2	5.2	7.2	6.9	7.5
1978	8.6	9.0	7.7	8.3	6.4	6.0	5.5					

development during the reproductive stages of growth which usually lasts for two months as follows:–

Off season 77	**Main season 77/78**	**Off season 78**
1. August	1. January	1. June
2. September	2. February	2. July

With reference to the histograms in *Fig. 1A*, temperature during the reproductive stages of the off season 77 and off season 78 (30° to 31.5°C) were lower than those of the main season 77/78 (32° to 33.1°C). The lower temperatures of the 77 and 78 seasons correlates well with the false smut in the field, where the total average disease score for the seventeen varieties were 2.3 and 3.9 respectively, compared to the high temperature period of the main season in which there was no disease *(Table 3)*. Rainfall in the 77 and 78 off seasons amounting to 4.2 mm to 13.2 mm seems to be related to false smut because the very low rainfal (2 mm) in the main season was associated with no disease *(Fig. 1B)*.

The low sunshine hours in the 77 and 78 off seasons amounting to not more than 6 hours per day seems also to favour false smut for the high sunshine hours of 8 to 9 hours per day of the main season there was no disease.

It is also noticed that the total average disease *(Fig. 1C)* during the 78 off season (average score of 3.9) was higher than that of the 77 off season (average score of 2.3) – *Table 3*. This may have been caused by the lower temperatures and higher rainfalls of the 78 off season *(Fig. 1A and B)*. These factors have also been reported by OU (1972) as favouring false smut.

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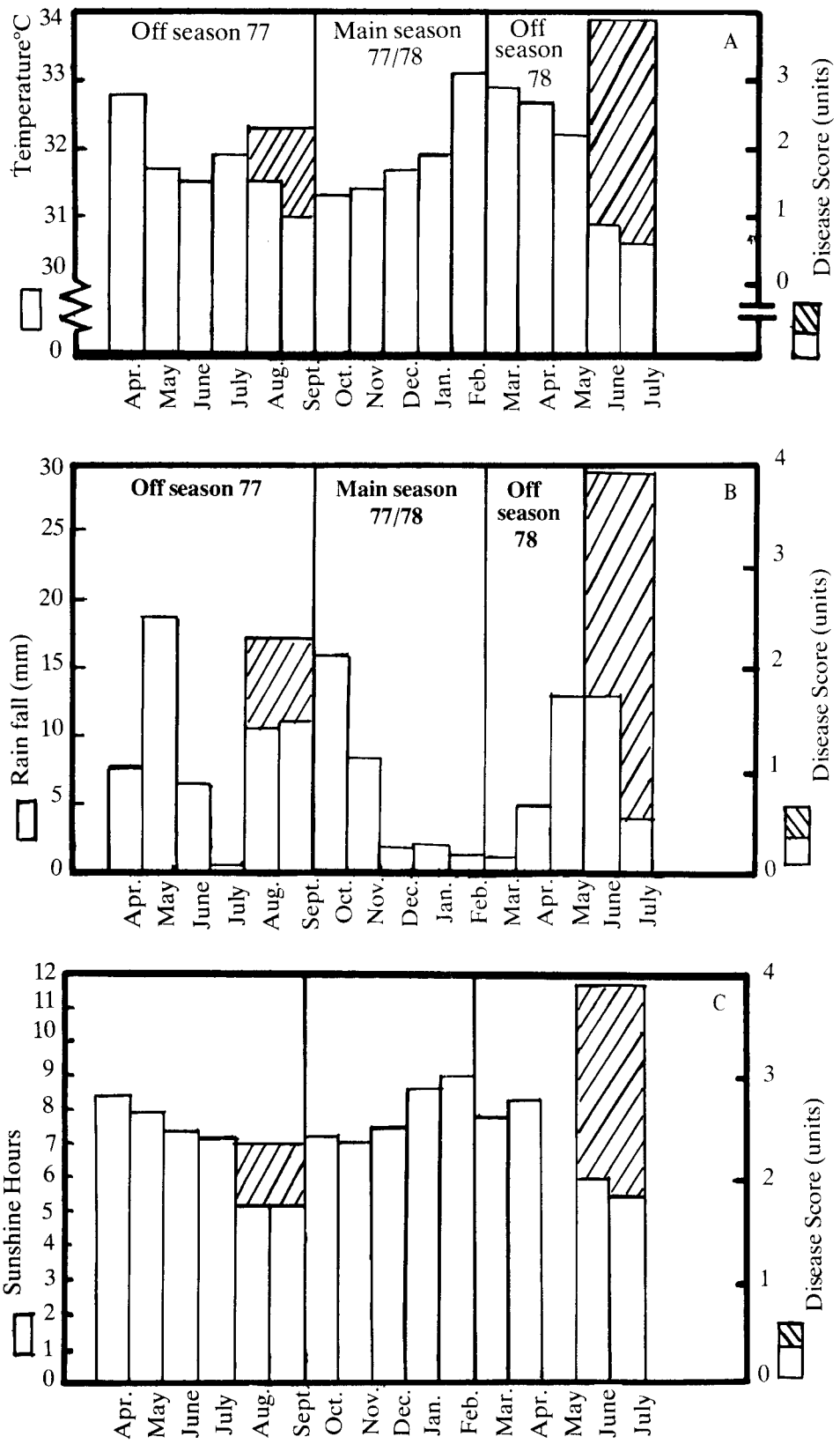

Figure 1. Development of false smut of rice in relation to temperature, rainfall and sunshine hours for three successive seasons (1977–1978) at Bumbong Lima.

SUMMARY

In the carry over of the false smut pathogen of rice from season to season, seasonal variations in climatic factors appeared to be much more important than types of seed. Temperature, rainfall, and sunshine hours seemed to be important in affecting incidence and severity of false smut. Low temperatures, high rainfalls and low sunshine hours per day, are favourable for disease development. This was particularly true in off season's plantings.

There were pronounced differences in resistance among the seventeen varieties tested. A few maintained the same resistance for the two successive off seasons, whereas others became more susceptible under the influence of conducive climatic factors in the second off season.

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