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SURVEY OF PINEAPPLE FRUIT COLLAPSE (CAUSAL ORGANISM: *ERWINIA CHRYSANTHEMI)* IN SELANGOR AND JOHORE

W.H. LIM* and P.H. LOWINGS**

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RINGKASAN

Sejumlah 80 kebun kecil dan dua estet nenas di Johor serta 9 kebun kecil di Selangor telah digunakan untuk membuat bancian kejadian penyakit buah hantu (fruit collapse) yang disebabkan oleh *Erwinia chrysanthemi.*

Kawasan nenas terutama di daerah Pontian, Jerami Batu, Rimba Terjun dan Rengit/Machap menunjukkan rekod kejadian penyakit buah hantu yang tinggi, sementara di kawasan Muar/Ayer Hitam dan Kelang kejadian penyakit ini adalah sedikit atau tiada langsung. Kejadian penyakit yang amat rendah ini disebabkan pengeluaran bunga secara paksa kurang dijalankan; dengan amalan paksaan pengeluaran bunga yang kurang, persamaan buah berpenyakit (sumber kuman yang utama) dan buah berbunga (tempat kemasukkan kuman) dapat dihindarkan.

INTRODUCTION

Fruit collapse of pineapple, a disease caused by a bacterium identified as *Erwinia chrysanthemi* Burkh. *et al.*, by LIM (1974) was first observed in the district of Pontian, Johore in 1935 (THOMPSON, 1937). Early reports of this disease and bacterial heart rot (caused by the same pathogen) were all from Johore State. In 1955, heart rot was found for the first time outside Johore, in the Sekincan area of Selangor and in 1956, in Jalan Kebun (Selangor) and South Perak (JOHNSTON, 1957a). Fruit collapse was also observed in South Perak in 1956 but not in Selangor (JOHNSTON, 1957b).

The present survey is aimed at (i) appraising the present disease situation (ii) determining the extent of disease distribution in the states of Johore and Selangor (iii) obtaining first hand information on the farmer's experience with the disease and (iv) relating observations thus made with the present knowledge of the disease.

MATERIALS AND METHODS

Selangor and Johore, the two states growing pineapple for canning in W. Malaysia, were covered by the survey. In order to get even representation of the disease distribution of the two States, a stratified sampling procedure was adopted. Areas were divided according to mukims or sub-districts. A list of farmers' names and addresses in each mukim was obtained from the Malayan Pineapple Industry Board (MPIB). Random samples, comprising about three to five percent of farmers per mukim were taken.

A total of 80 farms in Johore and 9 in Selangor, representative of 7,683 ha. and 462 ha. respectively, were sampled *(Table 1).* Data of disease incidence of the two major estates were obtained separately from their own records.

*Present address: MARDI, Jalan Kebun, Kelang, Selangor, W. Malaysia.
**Present address: Dept. of Applied Biology, Univ. of Cambridge, England.

TABLE 1. SUB-DISTRICTS, SAMPLE SIZE AND TOTAL ACREAGE OF THE MAIN PINEAPPLE AREAS

	Mukim	Total (ha)	No. of farms sampled
(a)	**South Johore**		
	Api-Api	1088.6	13
	Ayer Baloi	430.2	4
	Ayer Masin	509.5	4
	Benut	243.2	5
	Jeram Batu	671.4	9
	Pengkalan Raja	329.0	4
	Pontian	701.7	7
	Rimba Terjun	1557.3	17
	Serkat	164.3	1
	Sg. Karang	678.7	6
	Sg. Pinggan	279.6	2
	Total	6653.5	72
(b)	**North Johore**		
	Ayer Hitam/Muar	550.8	4
	Machap/Kluang	273.6	2
	Rengit	204.8	2
	Total	1029.2	8
(c)	**Selangor**		
	Kapar	109.3	2
	Klang	96.7	1
	Jenjarom/Telok P. Garang	255.8	6
	Total	461.8	9

The survey was conducted by questionnaire in August 1972 for Selangor and March to April, 1974 for Johore. The assistance of extension workers were enlisted to interview the farmers personally. Information on farm size, age of planting, farmer's estimation of present and past incidences of pineapple fruit collapse, sanitation practises and various aspects of agronomy were obtained. On the spot estimation of the disease incidence in the farmer's holding was intended but because of the variability in age of the plants, that was not possible. For example, some farms were not yet in bearing, and many that were in bearing had fruits that were too young for symptom expression (symptoms usually appear at about two to three weeks before harvest). Disease incidence and its frequency as discussed here are, therefore, based on the farmer's own estimates. As fruit collapse is a familiar disease to the farmer and there are no other pineapple diseases similar to it, the farmer's information can be relied upon to a large extent. The mean disease incidence (for Johore) as presented in the results was calculated from the mean yearly estimates from 1970 to 1974.

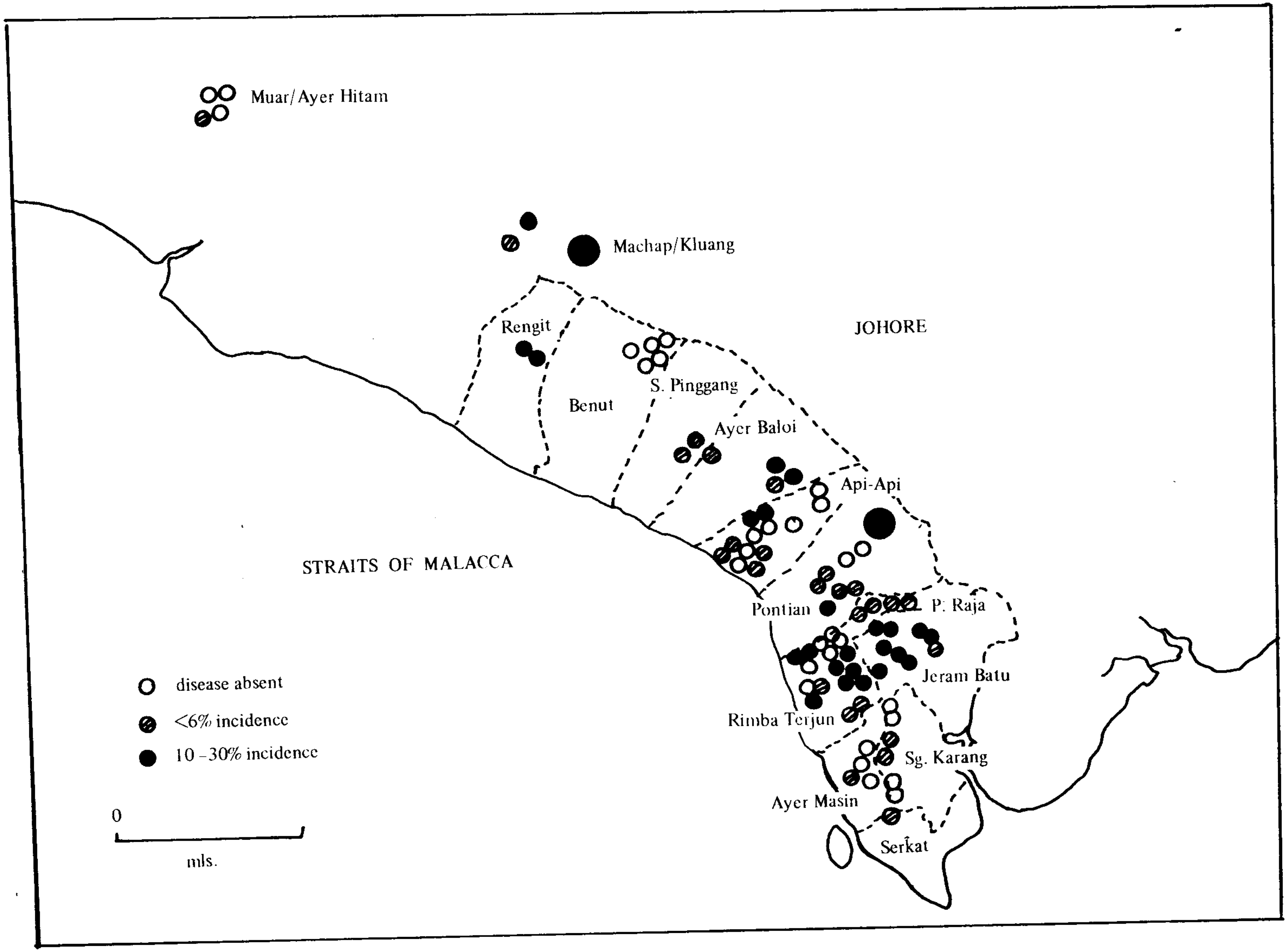

Figure 1. Distribution of pineapple fruit collapse in Johore. The larger circles denote estates and the smaller circles denote the smallholders.

RESULTS AND DISCUSSION

Disease distribution

Fig. 1 illustrates the distribution of the disease in Johore and indicates the disease incidence on the farms sampled. It is interesting to note that there is a concentration of the disease in the Jeram Batu/Rimba Terjun sub-districts in the South and in the Rengit/Machap sub-districts in the north where 65 percent and 75.0 percent respectively of the farms sampled had 10 to 30 percent fruit collapse incidence *(Table 2)*. The disease in the other four groups of areas was less widespread as 37.5–75.0 percent of the farms sampled were disease free.

TABLE 2. SUMMARY OF INCIDENCE OF FRUIT COLLAPSE IN THE VARIOUS SUB-DISTRICTS OF JOHORE

Groups of sub-districts	Percentage of farms		
	10–30% collapse	6% collapse	0% collapse
J. Batu/R. Terjun	65.4	15.4	19.2
Rengit/Machap	75.0	25.0	
P. Raja/Pontian/Api-Api	12.5	50.0	37.5
A. Baloi/Sg. Pinggang/Benut		36.4	63.6
A. Masin/Sg. Karang/Serkat		36.4	63.6
Muar/Ayer Hitam		25.0	75.0

In the Muar/Ayer Hitam sub-district, out of four farms surveyed, three had no disease and one had approximately 0.2% incidence. These areas had been in cultivation for 5 to 14 years. In the Benut area, none of the five farms had any disease and they had been in cultivation for 6 to 15 years.

Only one of the areas sampled in Selangor had fruit collapse; that area was in Jalan Kebun with an estimated incidence of 0.01 percent.

Acreage and age of holdings

The average farm size was 2.2 ha., with a range of 0.5 to 16.2 ha. Age of holdings averaged 12.8 years, with a range of 2 to 40 years *(Table 3)*.

In Johore, the oldest areas (40 and 34 years) were found in Jeram Batu and Rimba Terjun respectively, which were also the areas of heaviest concentration of the disease *(Fig. 1)*. The disease appeared to be practically absent from the Klang district in Selangor. Some of these areas have been cultivated with the same cultivar (Singapore Spanish) for as long as 30 years without the disease being observed.

Soil type

All of the farms surveyed, both in Johore and Selangor, grew pineapple on peat.

TABLE 3. AGE OF PINEAPPLE HOLDINGS ACCORDING TO SUB-DISTRICTS

Sub-district	Mean (years)	Range	Cultivar*
Johore			
Serkat	6	6	SS
A. Masin	10.0	8 -14	SS
Sg. Karang	11.3	5 20	SS
J. Batu	22.8	8-40	SS/MH
R. Terjun	14.7	2 34	SS
P. Raja	9.0	4 - 12	SS
Pontian	13.1	8 -18	SS
Api-Api	18.3	3- 23	SS
A. Baloi	13.0	7-30	SS
Sg. Pinggang	11.5	6 -17	SS
Benut	10.2	7 15	SS/M
Rengit/Machap	5.6	3-8	SS
Muar/A. Hitam	7.3	5 -14	MH
Klang			
Meru/Kapar	8.5	2 15	M
Kuala Langat	7	7	SS
Jenjarom/Bkt. Cheeding/ Kpg. Bharu	15.3	4 30	SS

*SS = Singapore Spanish
MH = Masmerah
M = Mauritius

Decrowning and deslipping

All of the farmers questioned practise decrowning and deslipping.

Stage of attack

Fruits are most commonly attacked at one month (3-4 weeks) from ripening, as reported by 91.8 percent of the farmers. Fifty-five percent of the farmers observed collapse on ripe fruits while 42.9 percent observed it on fruits two months before ripening (just after anthesis).

Incidence in neighbouring fields

When the farmers with fruit collpase in their fields were questioned about the presence of the disease in their neighbour's field, 80 percent claimed presence of the disease while the remainder were ignorant or reported absence. Conversely, of the farmers who had no disease in their areas, 97 percent knew of no such disease in their neighbour's field while three percent (one farmer) claimed that his neighbour's farm carried the disease.

Disease incidence and crop status

Out of 49 farms in Johore which have the disease, 10.2 percent of the farmers reported presence of the disease during the plant crop but not the ratoon, 51.0 percent reported disease on ratoon crops only, and 28.6 percent on both plant and ratoon crops. Of the remainder, 6.1 percent could only report presence of the disease on the plant crop as the first ratoon harvest had not yet been realised, while the rest (four percent), although having the disease in the ratoon crop, could not remember the disease status in the plant crop.

Disease incidence and age of holding

Of the farms which had the disease on their ratoon crops only, 28 percent developed the disease after 2 years of planting, 28 percent after 3 years, 20 percent after 4 years, 4 percent after 6 years, 12 percent after 10–19 years and 8 percent after 20–30 years.

Repeated and non-repeated disease incidence

Sixty-nine percent of the farms having the disease reported repeated incidence through the years, although the incidence fluctuated. It is interesting to note that 24.5 percent observed only one outbreak, following which practically disease-free harvests were obtained. For example, a farmer in Sg. Karang observed the disease in his holding in 1962 (about two percent incidence) but since then there has been no recurrence. Another recorded the disease two years ago in 1972 but has not observed it since. Such cases were recorded in most of the sub-districts surveyed.

Of the farms that had repeated outbreaks, the following observations were made:–

(a) 35.3 percent reported serious losses in the plant crop, declining with subsequent harvests.
(b) 2.9 percent had slight losses at plant crop, increasing with subsequent harvests.
(c) 50.0 percent had losses of about 5–10 percent at every harvest.
(d) 11.8 percent had losses of about 30 percent at every harvest.

Heart rot and fruit collapse

Out of a total of 55 farms which had fruit collapse and heart rot (a disease caused by the same pathogen), 63.6 percent recorded both diseases, 25.5 percent only fruit collapse, while 10.9 percent only heart rot.

Flower inductants and fruit collapse

Three types of flower inductants are commonly used, *viz.* NAA (either tablet or liquid), carbide or a mixture of NAA and carbide. It appears from *Table 4* that farms using NAA had proportionately less fruit collapse than farms using carbide. To conclude that the types of flower inductant applied are responsible could be erroneous as the use of the chemicals is not evenly distributed within the areas sampled.

Control measures

Fifty percent of the farmers experiencing fruit collapse in their fields practise sanitation, whereby the diseased fruits and/or plants are removed from their holdings. The rest allowed the diseased fruits and plants to rot in the field. It was observed that:–

TABLE 4. FLOWER INDUCTANTS AND PINEAPPLE FRUIT COLLAPSE

Flower inductants	Number of farms	
	Disease present	Disease absent
NAA	19	24
Carbide	25	2
NAA/Carbide	5	5

(i) in spite of sanitation practices, 37.5 percent of the farmers still experience more than ten percent fruit collapse incidence.

(ii) in spite of lack of sanitation practices, 36.0 percent of farms not practising sanitation still have below six percent fruit collapse incidence.

An interesting case was observed in Pengkalan Raja. The farmer in question observed high fruit collapse incidence in 1967 and 1968 when about 35% of the fruits were infected. In 1973 and 1974 the attack was minimal, estimated at 0.5%. One of his routines was to incorporate Dieldrex or DDT into his foliar sprays, applied at 6-month intervals for the control of field cockroaches. The practice commenced in 1968 but was stopped in 1974 when he stopped applying fertilizer.

CONCLUSION

The distribution map *(Fig. 1)* of the disease pin-points the sub-districts of Jeram Batu and Rimba Terjun, collectively constituting part of the main district of Pontian, as the 'centre' of fruit collapse. This is the same area where fruit collapse was first recorded (THOMPSON, 1937). It is most interesting to note that although the pathogen was observed in Klang, causing heart rot as long ago as 1955 (JOHNSTON, 1957a), the present survey in that district did not reveal any heart rot disease. Similarly, fruit collapse was observed there in only one area, at a low incidence of 0.01%. Yet these two districts, Pontian and Klang, have been growing the same pineapple cultivar (Singapore Spanish) for more than 20 years. It is strongly suspected that some external factor or factors to be discussed below, are responsible for the limited disease occurrence in the latter area. Possibly, the same factor operates in the Muar/Ayer Hitam area to account for the almost disease-free conditions there. The observation that some farms suffer the disease only once without subsequent occurrence for years, even in high incidence areas, suggests that the disease can be controlled once the factor is known.

Epidemiological studies done subsequently by LIM (1978) showed that the primary source of inoculum for fruit collapse is the freshly collapsed fruits and the primary infection site is the open flowers. In a ratoon field, the occurrence of both open flowers and collapsing fruits together would therefore lead to a potentially high disease incidence situation. By delaying forcing from 80 days to 120 days interval, thus avoiding the overlapping of open flowers and diseased fruits, LIM (1978) reduced the disease incidence significantly by more than 50% ($P < 0.05$). Thus three forcing rounds per year at four month-intervals is preferred to four forcing rounds per year at 80 to 90 day-intervals.

By the gradual elimination of the possible factors that may help explain the disease-free to almost disease-free situation in some of the localities studied, *viz.* Klang, Muar/Ayer Hitam and Benut, one factor, that of forcing interval appeared to offer the most plausible explanation. The frequency of forcing by the local farmers ranged from one to twelve times a year, the most common frequency as practised by 81% of the farmers being two to four times a year, with the larger farms forcing more frequently than the smaller farms (TAN, 1971).

Subsequent visits by the authors to farms in Benut and Muar/Ayer Hitam showed that the farmers in those areas forced the plants twice a year or at six month-intervals. At this interval, overlapping of open flowers and diseased fruits does not occur. In Klang, the farmers growing the canning cultivar do not practise flower induction at all, natural flowering which usually occurs twice a year in the ratoon crop, is allowed. Farmers who do not practise forcing and those who force at infrequent intervals, have therefore, unconsciously brought about almost disease-free situations in their farms. In constrast to the aforementioned areas, the commercial estates and many farms in areas surrounding the cannery at Pekan Nenas, *viz.* those in Pontian, Jeram Batu and Rimba Terjun, force their plants at more frequent intervals usually between four to six times a year (YUNUS, personal comm., TAN, 1971). The better road-infrastructure, improved accessibility, nearness to the cannery and stronger influence by agriculture extension workers have brought about increased output and thus more frequent forcing. It is those areas which have the highest disease incidence *(Fig. 1)*.

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SUMMARY

A total of 80 pineapple smallholdings and two estates in Johore and nine small holdings in Selangor were surveyed for pineapple fruit collapse, a disease caused by *Erwinia chrysanthemi*.

The central pineapple areas in the sub-districts of Pontian, Jeram Batu, Rimba Terjun and Rengit/Machap have high disease records while the more outlying areas in Muar/Ayer Hitam and Klang had disease-free to almost disease-free situations. The less frequent forcing (by the use of flower inductants) practised in the latter areas offers the most plausible explanation for the low incidence observed in those areas; with less frequent forcing, overlapping of disease fruits (the most important inoculum source) and open flowers (the point of entry) is avoided thus leading to reduced or no infection via the open flowers.

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