AA RESEARCH NEWS

May '91

EDITORIAL

The great disparity between the yield of cocoa in experimental and commercial plantings is a cause for concern.

Planters often wonder whether the high yields reported in the research trials are actually obtainable in commercial scale plantings. On the other hand, research workers are puzzled at the poor performance of their experimentally proven planting material in the hands of the planters.

Clearly, something is amiss somewhere.

It is true that most of the yields reported by the research workers are often extrapolated. However, there is little reason to doubt their integrity although some of the estimates may be higher than the actual yields because of the inherent problems involved.

A recent study carried out in Papua New Guinea indicated that yields based on pod count in the trial areas need to be multiplied by a factor of 0.83 to obtain the actual yields achieved for breeding trials.

However, the 17% overestimate obviously cannot account for the great differences between the experimental and commercial yields which we often encounter.

The yield potentials of our current planting material whether they are hybrid seedlings or selected clones are well over 2 t/ha, whereas our national average is running at well below 1 t/ha.

Although the majority of our estates yields are better off than the national average, there is still much room for improvement.

It is encouraging to note that many of our estates have made big advances in yield improvement in the last few years. Some estates have already achieved fairly good yields of about 1.5 t/ha. In fact some of the fields had even been able to come very close to the 2 t/ha mark.

In this issue of our Newsletter, our Goh Kah Joo and Samsudin Amit put forward this provocative question: Are High Cocoa Yields Possible in AAR Advisory Estates?

Well, the answer depends very much on the planters who are the most important link in the production chain. We would be very glad to hear and publish the planters' views on the subject.

Ooi , L.H.

INSIDE

- Crop News ▬
  Are high cocoa yields possible in AAR Advisory Estates?
- Highlights of Workshop
  - "Phosphate sources for acid soils in the humid tropics of Asia"
- Home News ▬
  The Pride of AAR
  The Sg.Buloh Tragedy

NEWS ON THE HOME FRONT ...

The Pride of A . A . R .

More news..... P 7,8

ARE HIGH COCOA YIELDS POSSIBLE IN AAR ADVISORY ESTATES ?

Goh, K.J. & Samsudin A.

1. INTRODUCTION

Recently, Ooi (1989) showed that achieving high yield is the most effective manner to reduce production cost and therefore improve profitability of cocoa cultivation. In fact, a cocoa yield of more than 1500 kg dry bean/ha/year is necessary to maintain our estates' competitiveness and cushion the effects of low cocoa prices.

Corley (1985) worked out the theoretical cocoa yield potential to be approximately 11 t/ha/year dry bean. However, long-term breeding trials achieved only 3,883 kg/ha/year in Malaysia (Ooi *et al*, 1989) while for small areas yields up to 4,445 kg/ha/year have been reported (Chan *et al.*, 1989). For large commercial fields, the better yields in Malaysia ranged from 1600 to 2200 kg/ha/year (Lee and Goh, 1989 and Thong *et al.*, 1989). Hence, high cocoa yields exceeding 1500 kg/ha/year are indeed realisable in Malaysia.

In AAR advisory estates, the 1989 cocoa yields of fully mature plantings ranged widely from 217 to 1,964 kg/ha and only 6% of the fields exceeded 1500 kg/ha. Hence, our estate yields were still mainly low when compared with the yield target and better commercial yields as mentioned earlier. Moreover, our recent soil survey and feasibility studies indicated that most fields achieved less than 70% of their respective predicted site yield potentials.

These generally poor yield performances could be attributed to numerous factors which affect cocoa yield (Goh, 1988, Lee and Goh, 1989 and Thong *et al.*, 1989) and it will be useful to identify the probable measures which we can utilise to achieve high yield and good performance in the near future.

2. COMMON CAUSES OR EXCUSES FOR POOR YIELDS

At the 1989 workshop on "Cocoa Agricultural Research" organised by Malaysian Cocoa Growers' Council and Malaysian Cocoa Board, it was often pointed out that the main yield constraints were planting materials, planting density, shade regime, nutrition, pest and disease (P&D) control and weather.

With good P & D control and harvesting, we can exceed the yield target of 1500 kg dry bean/ha/year & achieve constant good yield performances

These aspects have prompted major research efforts by many organisations. For example, a total of 664 families of seedlings are currently being screened in Malaysia alone and more than one thousand accessions of cocoa planting materials have been imported for breeding (Ooi *et al.*, 1989).

Are these the real causal factors for the present poor yield performances?

Probably not! One should also realise that the above research efforts offer mainly medium to long term solutions apart from P & D control and our cocoa estates just may not survive the wait for the answers.

High density planting has attracted a lot of interest lately but would require long-term yield results to ascertain its economic viability. Moreover, results of spacing trials (Lim *et al.*, 1986) indicated that the current planting density is sufficient to achieve high yield. So really, do we need to resort to such speculative expensive measures now?

Furthermore in our advisory estates, nutrition is generally well taken care of; improvement in the productive stand per hectare of existing fields is an on-going exercise; shade is now at its bare minimum and no super planting material is within sight.

So where should we look to improve our current yields to ensure good profit and maintain competitiveness?

Some interesting examples are now available from recent results from two AAR trials on cocoa nutrition in Sabah on comparatively well managed estates.

3. CROP LOSS

In cocoa estates, crop loss can occur in three major ways, namely,

a) direct loss of pods or beans,
b) drastic loss of cocoa trees to the extent that existing trees cannot compensate for the vacancies, and
c) loss in tree vigour resulting in poor fruit set and podding.

This paper will only discuss the extent of direct loss of pods in cocoa fields due to P and D.

The causes for low cocoa stand and its effect on yield were elucidated by Goh (1988) while Thong *et al.* (1989) attempted to evaluate the factors affecting tree vigour and their effects on yield. further details.

3.1 DIRECT CROP LOSS

As mentioned earlier, the results presented here are derived from two AAR trials which are primarily meant to investigate the nutritional requirements of cocoa. However, the P&D pod losses were recorded and categorised according to the causes of damage at each harvest. This allows us to examine closely the extent of crop loss in cocoa estates.

Crop obtained in the trial sites included extractable beans from CPB (Cocoa Pod Borer)damaged pods. The mean trial yields were approximately 56% above the estate yields (Table 1). This was despite the extremely high crop loss of 27% of its realisable yield of 2286 kg/ha/year in Trial A. In Trial B, crop loss was lower probably due to its younger age and hence, the smaller canopy sizes and height. Therefore, P and D control was probably more efficient.

Of major concern is the high crop loss in the trial sites which are assumed to be reflective of the estate situations in view of their lower croppings and that P and D control in the experiments was conducted by the estate.

An analysis showed that pod damage suffered at the commencements of trials A and B were 44.2% and 21.7% respectively (Table 2). These could be translated into crop losses of 241 kg dry bean/ha and 72 kg dry bean/ha for the two trials respectively. The estimated crop loss in 1989 for Trial A was 615 kg dry bean /ha.

The above extrapolations were made using a planting density of 1187 cocoa trees/ha and pod values of 28.1 and 29.7 for trials A and B respectively. These pod values were recorded from the trial sites in November 1989.

It was also interesting to note that P and D losses were relatively higher during the low cropping months. This could be attributed to the reduced P and D control measures during the period. However, as shown in Table 2, during the low cropping period eg. the third quarter of Trial A, crop loss could still be substantial at 119 kg/ha. Therefore, we should re-examine our P and D control approach in view of the very high losses that can occur.

Table 1: Comparison of trial site yields and neighbouring field yields in 1989.

Particulars	Trial A	Field A	Trial B	Field B
Hectarage	12.0	48.0	2.0	149
Year planted	1980	1980	1987	1987
Trial commencement	Jan, 1989	-	July, 1989	-
Crop recovered (kg/ha/yr)	1671	1158	1118	664
Crop loss (kg/ha/yr)	615	-	139	-
Realisable yield (kg/ha/yr)	2286	-	1257	-

1 Six months yield record

Table 2: Crop loss due to pest and disease (P&D) damage

Trial	Quater	Cropping Period	Pods/tree Good	Pods/tree P&D	Pods/tree Total	% damaged pods	Estimated crop loss (kg dry bean/ha)
A	1st	Low	7.2	5.7	12.9	44.2	241
	2nd	High	12.3	4.4	16.7	26.3	187
	3rd	Low	4.9	2.8	7.7	36.4	119
	4th	High	15.0	1.7	16.7	10.2	68
		Total	39.4	14.6	15.0	27.0*	615
B	3rd	Low	6.5	1.8	8.3	21.7	72
	4th	High	20.7	1.7	22.4	7.6	67
		Total	27.1	3.6	30.7	11.7*	139

* Weighted averaged % damaged pods

Table 3: Categories of pest (CPB) and disease (PBP) damaged pods in trial sites in 1989

Trial	Quarter	Cropping Period	% total damaged pods CPB	% total damaged pods PBP	% of total pods CPB	% of total pods PBP
A	1st	Low	82.6	17.4	36.5	7.7
	2nd	High	89.6	10.4	23.6	2.7
	3rd	Low	90.6	9.4	33.0	3.4
	4th	High	55.6	44.4	5.7	4.5
	Total*		84.1	15.9	22.7	4.3
B	3rd	Low	96.0	4.0	20.8	0.9
	4th	High	76.0	24.0	5.8	1.8
	Total*		86.7	13.3	10.2	1.6

* Weighted average percentage for 1989

The main P and D in the trial sites were CPB and Phytophthora Black Pod (PBP). CPB accounted for about 85% of the total damaged pods (Table 3) despite the regular control treatment.

In both experiments, P and D control was carried out by the estates. However, with clean harvesting at 10-day intervals, removal of all P and D damaged pods from trial sites and additional target spraying when necessary (such as wash-outs) in the trials, CPB infestations were effectively reduced in the second quarter in Trial A (Table 2). During the third quarter, CPB incidence resurged which coincided with the low cropping period, abated control treatments and enlarged plot size from 16 trees to 36 trees. The effect of increased plot size on higher cocoa crop loss might be ascribed to the poorer CPB control of pods on the upper canopies of earlier border trees by the estate. These pods were also not effectively harvested resulting in high CPB infestation (Wood, 1987). A similar control measure was again

imposed in the following quarter and CPB pod loss was reduced to 5.8% of total pods produced.

Black pod incidence was also high in Trial A at commencement but again, with clean and regular harvesting, the damage declined to 4.5% of the total pods. This result conformed with the findings of Medeiros (1977).

Apart from good supervision of treatment and harvesting, the monitoring system should be reliable to complement the P and D control. It should project an accurate assessment of the situation and allow the correct management decisions and inputs to be made. This does not appear to be the case (Table 4).

Although the trial sites showed extremely high crop loss, the field monthly census results showed very low unextractable beans. The quarterly fluctuations of CPB damage were also unacceptably small, even against published data (eg. Day, 1989). These low crop loss figures provided by the censuses might cause a false sense of security to prevail in the estates. This might lead to detrimental consequences as shown by the serious crop losses in the trial sites and probably in the estates also (Table 3).

It is perhaps time for us to scrutinise the present P and D monitoring system objectively for its ease, reliability and role and re-examine the whole system of implementing P and D treatments for effective control.

Table 4 : Comparison of CPB census figures and crop loss from trial sites and respective estate fields.

Site	Crop damage	Quarter 1st	2nd	3rd	4th	Weighted average
Trial A	Unextractable(%)	44.2	26.3	36.4	10.4	27.0
Field A	Unextractable(%)	1.5	2.1	2.1	0.8	1.5
	% infestation	29.5	29.5	41.2	23.4	27.6
Trial B	Unextractable(%)	-	-	21.7	7.6	11.7
Field B	Unextractable (%)	-	-	2.1	2.0	2.2
	% infestation	-	-	18.6	29.2	29.0

4. CONCLUSION

The examples cited revealed that oversight of P and D losses and false security from poor assessment results have very important and immediate implications. Good P and D control is essential in achieving high cocoa yields and it cannot be overemphasised. It is probably the most yield limiting factor in our cocoa estates now.

Crop loss ascribed to CPB and PBP has been as high as 37% of recovered crop or 615 kg/ha/year. This could be substantially reduced through proper and timely P and D control, good monitoring and clean regular harvesting. There is still considerable scope to improve quality of work on P and D control and monitoring system.

Further work to develop an efficient system of P and D control on the cocoa estates is required.

With good P and D control and harvesting, we can exceed the yield target of 1500 kg dry bean per hectare per year and achieve constant good yield performances.

So let us all work together to improve the profitability of cocoa cultivation and ensure its viability instead of being lulled to complacency and perhaps, defeat!

High yielding cocoa tree

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Highlights of workshop on

"PHOSPHATE SOURCES FOR ACID SOILS IN THE HUMID TROPICS OF ASIA "

INTRODUCTION

This closed workshop was jointly organized by the Malaysian Soil Science Society and Rubber Research Institute of Malaysia. It was sponsored by the American Phosphate Foundation, World Phosphate Institute and Potash and Phosphate Institute. It was held on 6th to 7th November, 1990 for invited participants working on phosphate.

Since the end of the 19th century, the use of rock phosphate for direct application has been the focus of considerable interest and research throughout the world. However, the P availability from rock phosphate in humid tropical countries such as Malaysia, differs markedly from that in temperate countries. Hence, the main objective of this workshop is to deliberate the relevant findings on P use in the humid tropics.

Three AAR's officers, Messrs. Chew Poh Soon, Kee Khan Kiang and Goh Kah Joo attended the workshop.

The highlights of the workshop are discussed under the following headings for clarity:-

P mineralogy
P chemistry
P uptake
Standardised index and test ing
P use and
Future work

P MINERALOGY

Approximately 81% of rock phosphate fertilizers is of sedimentary origin. This resulted in highly variable mineral compositions in the fertilizers even for those coming from the same mine. Also of major concern is the fact that only 43% of rock phosphate sold in 1989 had phosphate content above 32% compared with 83% of rock phosphate delivered in 1976 with similar grade.

Therefore, a proper understanding of rock phosphate is needed to make effective intelligent decisions concerning the use and effectiveness of rock phosphate from different sources for our plantation crops.

P CHEMISTRY

A number of papers discussed how rock phosphate dissolved (P dissolution) in acidic humid tropical soils. The general chemical equations for P dissolution are:-

Rock phosphate (Ca, Na, Mg, PO_4, CO_3, F) ——> P by

a) $PO_4^{-3} + 2\ H^+$ - —> $H_2PO_4^{-1}$
b) $CO_3^{-2} + 2\ H^+$ —> $H_2O + CO_2$
c) $F^- + H^+$ —> HF
d) $2\ HF + Ca^{2+}$ ——> $CaF_2 + 2\ H^+$

From the above equations, it can be deduced that the rate of rock phosphate decomposition will increase if one or more of the following conditions exist:-

a) High P sorption capacity and low soil solution P concentration.
b) High soil acidity and capacity to supply H^+
c) Low soil solution Ca but high capacity to absorb Ca^{2+}.
d) High F- in the rock phosphate.
e) High soil moisture content.

The other factors which can improve rock phosphate dissolution in soils are high surface area and percent of carbonate substitution in the fertilizer; high iron, aluminium and organic matter contents in the soil; and high degree of mixing the rock phosphate with the soil and low rate of rock phosphate application.

The above results indicate that most Malaysian soils which are classified under humid tropical soil will favour rock phosphate dissolution because they generally have low soil solution Ca and P and high soil acidity and P sorption capacity.

Hence, even low reactive rock phosphate such as China Rock Phosphate will completely decompose after five years in highly weathered soils in the humid tropics.

P UPTAKE

Lately, numerous reports from the humid tropical countries indicated that a number of perennial and annual crops on acidic soils gave comparable response to rock phosphate and triple superphosphate or diammonium phosphate (DAP)

Similarly, PORIM, RRIM and IOI (ex-Dunlop Estates) respectively showed that oil palm, rubber and cocoa responded well to rock phosphate fertilizers.

In pot study using maize, the fertilizer efficiencies of P sources on Serdang series soils in Malaysia after a year were:-

i) Triple superphosphate (TSP) = North Carolina Rock Phos phate (NCRP) = Moroccan Rock Phosphate (MRP) = Jordan Rock Phosphate (JRP) = 9 to 10%.

ii) Christmas Island Rock Phos phate (CIRP) = China Rock Phosphate (CRP) = 6.5%

A closer analysis showed that in the first six months,

TSP = NCRP = MRP = JRP > CIRP > CRP;

while in the second six months,

NCRP > JRP = MRP = CRP > TSP = CIRP.

The above results indicated that soluble P source (TSP) was effective for short-term only while the less soluble P sources such as China Rock Phosphate performed well in the longer term.

The facts presented so far imply that soluble P sources such as TSP and DAP should be used only if quick P correction or requirement is needed and in soils with high pH and calcium content. Otherwise rock phosphate is likely to be more effective for perennial crops such as oil palm, cocoa and rubber which have long term requirement for P.

STANDARDISED INDEX AND TESTING

In view of the many P sources in the market and their high variable mineral composition, a standard index for rock phosphate will be useful.

Currently various tests are available based on fertilizer mineralogy, chemistry or combination of fertilizer and soil chemistry.

In Malaysia, we generally use total phosphate content, 2% citric soluble P and particle sizes to determine the rock phosphate quality. Currently, the other methods did not give significant advantage over the above tests.

In the workshop, Sinclair *et al.* proposed an interesting index for rock phosphate using,

a) rock phosphate reactivity
b) rock phosphate dissolving ability of soil and
c) crop factor

However, more work is required before it can be adopted.

P USE IN MALAYSIA

In 1989, Malaysia imported 390,000 tons of P fertilisers. Most of them came from China, Morocco, Jordan and North Carolina. CRP and NCRP came in ready form for application while MRP and JRP required to be ground first. There are currently ten mills located in the North region (Prai), Central region (Port Klang/ Padang Jawa) and South region (P. Gudang). They have the combined capacity to process 2210 mtons of rock phosphate per day.

Approximately 50 to 60% of the fertilizers was applied directly while the balance was used for manufacturing compound or mixture fertilizers. The plantation sector consumed about 25% of the P fertilizers.

The cost of transport for Sabah and Sarawak from West Malaysia was high at $137 to $157 per ton. Hence, it was much cheaper to import CRP directly into East Malaysia.

FUTURE WORK IN AAR

With the wide variety of P sources and prices coupled with the varied soil types, it is essential for us to always recommend the right choice and rate of P fertilisers for our plantation crops. We also need to improve the efficiency of P fertiliser in order to reduce our cost of production. Thus, since three years ago, AAR has embarked on a major P research programme to investigate the followings:-

P requirements of oil palm and cocoa in Sabah
Index for rock phosphate
Soil ability to dissolve rock phosphate
P availability of rock phosphate and soluble phosphate
Residual value of rock phosphates
Economics of P fertiliser use
Soil and foliar tests to monitor P response
System modelling of P requirement of oil palm and cocoa

Incidentally, our research programme is similar to the future work outlined and discussed by most participants in the workshop.

Goh,K.J.

SPORTS NEWS

AARSC - KELKOSC Games

On 20-21st April,1991, a busload of KelkoSc stalwarts led by their President, Mr. Tham Chee Ping descended on AAR for the 1991 rematch of the annual AARSC-KelkoSc Games. They brought the challenge trophy with them to be given away but carted it back again but not without some hard tussle from AARSC members. AARSC was so close to victory after leading 2 games (badminton, table-tennis) to 1 (carroms) on the first day but was let down by their team members in football and volleyball.

The visitors left for home exhausted after all the shopping, midnight carousing besides the games, but nevertheless happy emerging winners and given free AAR fertiliser samples.

Yeh/ that's it.....

After a rought time, a well deserving break. .....Mmmm..

Continue from P 1.....

NEWS ON THE HOME FRONT

The Pride of A A R

— New AAR Office Complex

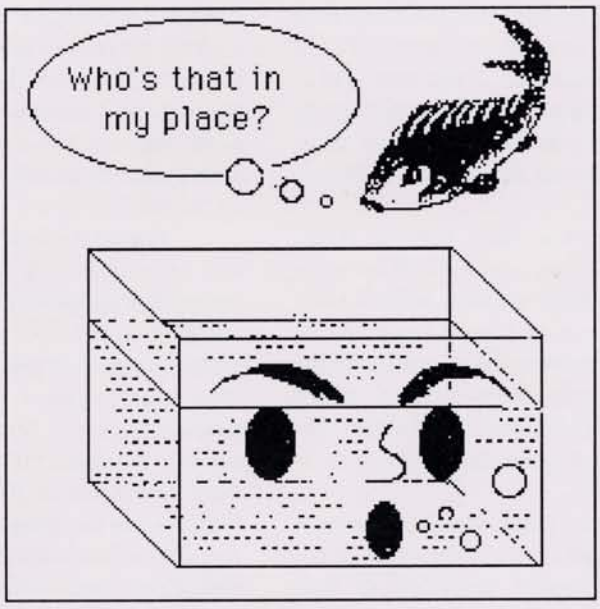
Julie, Y

The excitement was in the air.

It was not quite as though we were moving from a Victorian mansion to an ultramodern high rise glassy office complex. Although it did give a bit of that feeling when we were shifting to AAR's new office from 18-20th February, right after Chinese New Year! Perhaps it was also the culmination of a long anticipation and that it coincided with a festive season making it a real auspicious occasion.

Located just opposite the KLK bungalows which used to be our office premises, the New AAR office occupied a part of the Bujong Division, Coalfields Estate. Some of the old oil palm trees were felled to give way for the construction. Work on the new office site commenced back in late -1990 and by mid-February, exactly 6 months, the New AAR Office Building was completed.

From an aerial view, the single storey complex sports a T-shape-look, with an area of approximately 700 sg. metres. As you drive through the entrance, you will be greeted with pots of beautiful palm trees and colourful bougainvilleas, fronting a modern building with a slight mock Tudor facade. Most parts of the building structure are enclosed with crystal clear glass planes, giving us a good view of our surroundings. As someone once joked" **I felt like a gold fish, peeping out from the aquarium**". He rightly summed it up. Although the feelings of exposure and self-consciousness however gradually dissipated once we got used to the new environment and reverted back to routine.



The Oil Palm/Plant Breeding Section now occupies the left wing of the building and the Rubber/Cocoa Section on the right wing. The main section of the building is taken up by the Admin./Clerks/Statistics/Computer and Accounts Department. This new set-up provides effective work co-ordination and communication. Interactions between staff and manangement have greatly improved, unlike the former offices. Those days of hassles with flights after flights of stairs were over: no lugging up heavy briefcases loaded with work assignments, no more tripping over and no more "elephant stampede" at closing time! But we havc to sacrifice some loss in privacy and free exercise.

Just directly behind the complex, about 200 metres away, the Seed Production Lab is under construction and will be ready soon.

Two of our former office premises, the KLK bungalows, have been converted back into residential quarters for staff and families. Bungalow 2 still houses the Canteen and the Sport's Club's recreational facilities.

To coincide with the new move and the Chinese New Year celebration, the Management hosted a BBQ lunch party for the staff/workers and invited guests from surrounding associated estates. Spanish rice, satay, rendang and burgers were some of the more appetizing items featured in the menus.

Credit for this majestic building should be given to Mr. Tan Cheng Chua, our Research Officer cum "Site Engineer" of the Building Project, for his tireless efforts in getting the building completed ahead of schedule. Come rain or shine, he would be there at the site, doing the necessary to ensure a good and timely job done - A BIG THANK YOU.

Back to the grind?

Illustration by TSH

LOOK OUT FOR OUR NEXT EXCITING ISSUES !!!

EXPLOSION, COMMOTION

THE SG. BULOH TRAGEDY

Julie, Y

On this hot sweltering afternoon, at about 3.30 p.m. on May 7th, a succession of loud explosions, rocked our office complex, sending us scuttling out into the open for fear that our pride the New AAR office might just collapsed on us. The tremendous force caused windows to rattle and crack; some ceiling boards gave way and lights were dislodged hanging precariously over our heads.

Our inital thought was the usual rock blasting carried out from the nearby PLUS highway construction site. Some even speculated that the weapons factory located inside the Army Camp was the cause. Later news confirmed that it was the fireworks factory that exploded.

For those who have been to AAR, about a kilometre away, you would have noticed a "little" village slightly nestled away from public eye, except for the better known Leprosarium Settlement where you could get your hands on some cheap flowers, indoor plants and pots. There were hardly any unusual excitement or activities to warrant or attract your attention.

Through the years, many businessess and shops have sprung up in the midst of the village. These factories, regardless of their status have in fact provided a steady source of income and job opportunities to the residents of Sg. Buloh. Life would have gone on peacefully but it took an unfortunate incident like this to change the whole course.

According to sources, the factory usually ran tests on the fireworks in the evenings but on this fateful afternoon, the tests were carried out earlier. They misfired and sparked off a continuous chain of reaction, setting the whole factory ablaze. Some quick-action staff members managed to save themselves when they threw themselves over the gate, while some others dived into the drains. Those trapped in the factory were either burnt beyond recognition or blown to pieces. Some passersby and "good samaritans" were killed by the flying debris.

A large mushroom cloud of ash and toxic gas ballooned up int the air. Minutes later, thick black fumes darkened the sky and fire broke out. Coupled with the day's heat, the intense fire could be felt and seen miles away. Minor crackling explosions followed. The explosions took many lives. Houses and shops within a kilometer radius were flattened. It also left many homeless and jobless. Stories abound both eye-witnessed and non-eye-witnessed, while some were spiced up sounding rather bizarre, verging on the gory or gruesome details.

Before the first shock was over, we were told to evacuate. A strong rumour was going around that the whole place was sitting on a time-bomb as about 300 tons of explosives were buried underneath the fateful factory and at the slightest provocation , it could trigger off another massive explosion. Someone with a wry sense of humour remarked ***"You might just report for work tomorrow to find your new office has crumpled to the ground!"*** For days, the place was abuzzed with activities. It attracted the attention of everyone : right from the news media, to royalties, environmentalists, spilling over to the public. The area within a 2 kilometre radius were cordoned off to allow the authorities concerned to monitor the situation. Finally experts were roped in to remove the massive underground storage.

Phew! What a relief when assurance of safety was given by the authorities! Until today, if we should happen to mention to any new acquaintance that we work at Sg. Buloh, they are sure to exclaim "The explosion place, eh? How was the explosion? Did you see it ? "

"Well, the story goes like this .....".