AA RESEARCH NEWS

May '89

EDITORIAL

Crop Yields

High crop yield or productivity is the main concern of all in the plantation industry. It determines the competitive ability and profitability of any crop industry. It begins at the estate level and works its way through to the company and the country's industry levels. And, furthermore as emphasised by Tan Bock Thiam in his analysis of the profitability of oil palm cultivation in the 1987 International Oil Palm Conference and by Ooi Ling Hoak, in his article in this Newsletter for cocoa, increased crop yield is the surest way to achieving high profits. This comes about not only through increased revenue but also through reduced production cost.

But what determines high yield and how can we achieve it? The yield or yield potential of a crop depends on its genetic yield potential (i.e. genetic make-up) and the environmental yield potential (environmental conditions).

The genetic yield potential is defined as **"The yield potential of a cultivar (plant variety) grown in environments to which it is adapted with nutrients and water non-limiting and with pests, diseases, weeds and other stresses effectively controlled".**

The provisos in the above definition described the factors involved in the other component affecting the yield potential i.e. environmental potential. However for analytical purpose, the environmental potential can be divided into the site yield potential defined as **"The maximum yield attainable for a particular plant variety grown with optimum agronomic and management inputs under the specific conditions of the site (including soil and climatic limitations)"**, and the agronomic and management capability or potential as indicated in the definition.

The genetic yield potential can be increased by introduction of new improved cultivars through breeding. The site potential is pretty much dictated by the climatic and soil conditions (NB. The feature article in the previous issue discussed the climatic limitations), although the effects can sometimes be ameliorated agronomically. The agronomic and management potential is of course under the control of the agronomist and the management.

Reports of very high yields obtained from certain locations planted with not particularly superior planting materials seem to suggest that the yield potentials of current planting materials are very high relative to commercial yields often seen (This is not to say that there is no further need for breeding and planting material selection).

The reasons why such yields have not been obtained on a more widespread basis, may be attributed to effects of non-genetic factors. Increasing reports of cases of significant improvements in crop yields from areas of apparent poor site yield potentials have demonstrated the important contributions of agronomic and management expertise in attaining high yield and this will continue to do so.

This issue of the Newsletter has as its main feature the analyses of the crop yields of recent years. Annual crop yields are routinely analysed by AAR agronomists. In the analysis of the crop yield, the agronomist not only seeks to explain the existing yield pattern but also to build up his database to help him draw up the site yield potential and the agronomic inputs required to achieve it. Ideally, the agronomist should be able to build up enough information and knowledge to be able to predict reliably the expected crop yield with respect to location, agronomic inputs, crop age and time or season.

HIGHLIGHTS

- **Analyses of Crop Yields**
- **Production Cost Equation In Cocoa**
- **Fertilizer Briefs**

ANALYSIS OF 1988 COCOA YIELDS

INTRODUCTION

In 1988, AAR provided advisory services to 25 cocoa estates with a total mature area of 11,087 hectares.

The estates were scattered throughout Malaysia. For the purpose of the current study, they have been broadly grouped into the following regions:-

Region	No. of estates	Total hectares (1988)
Tawau	9	3773
Sandakan	5	3191
Lahad Datu	5	3115
Pen. Malaysia	6	1008
Total	**25**	**11087**

METHOD OF ANALYSIS

The cocoa yields for all the non-calendar year estates were re-computed on calendar year basis for analysis. Annual yield trends for 1986 to 1988 were analysed.

RESULTS

1986-1988 yield

Cocoa yield improved steadily for the period reviewed (Figure 1).

For Tawau estates, the yield improved from 626 kg/ha in 1986 to 1044 kg/ha in 1988, an increase of about 67%.

The corresponding figures for the other regions were:-

1) Sandakan
   - 241 kg/ha in 1986 and 743 kg/ha in 1988, an increase of about 208%.
2) Lahad Datu
   - 244 kg/ha in 1986 and 626 kg/ha in 1988, an increase of about 57%.
3) Pen. Malaysia
   - 596 kg/ha in 1986 and 887 kg/ha in 1988, an increase of about 49%.

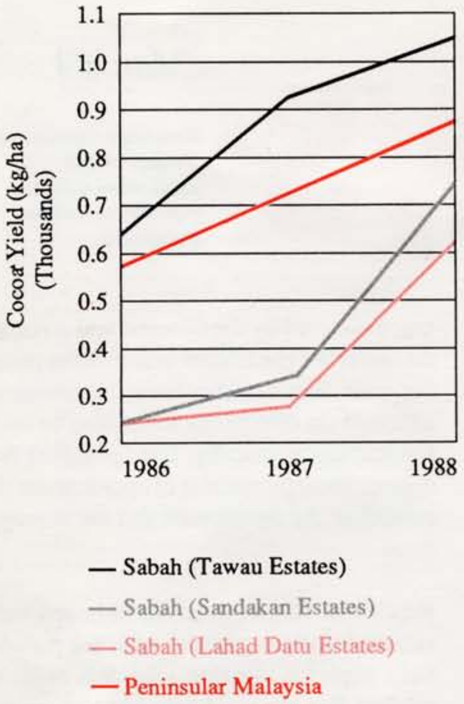

FIG.1: COCOA YIELD TRENDS FOR 1986-1988

In Sabah, the yields for Sandakan and Lahad Datu estates were much lower as compared to those obtained in Tawau estates.

This could be attributed to the poorer growing conditions, particularly the higher and less evenly distributed rainfall in the former two regions. The unfavourable weather not only affected the fruit set adversely, it also resulted in higher incidence of diseases particularly VSD (*vascular streak dieback*) which could cause severe terminal shoot dieback and defoliation, with consequent lower yields.

Apart from the above, the plantings in Sandakan and Lahad Datu were also generally much younger in age and consisted of mainly newly-matured cocoa which had yet to reach their maximum yields.

The soils on many of the Tawau estates were also more fertile and productive. For example on an estate where the bulk of the cocoa were on fertile volcanic soils, the yield was much higher (1428 kg/ha in 1988).

In Peninsular Malaysia, the cocoa estates were scattered over a wider range of climatic and soil types. One of the estates was located in a region with several months of continuous dry weather and hence recorded rather low yields for most of the years. All the estates had generally poor soil nutrient status. However, most of the estates were capable of yielding more than 1 t/ha of dry beans. The highest yield obtained was 1588 kg/ha in 1988. Although this was recorded in a small estate, nevertheless it is also a realistic target for the bigger estates.

Forecast for 1989

Current trend indicates that the 1989 cocoa yield will most likely register a decline for most of the estates in Sabah, the main reason being the unusually wet weather in 1988 and in early 1989. The unfavourable weather has affected the fruit set adversely. The ensuing VSD outbreak has caused even greater damage particularly in Sandakan and Lahad Datu. Most of the estates in Tawau have also suffered although not as badly. However cocoa on the fertile volcanic hills appeared to have escaped the VSD scourge and will therefore be able to produce a good crop probably in excess of 1.5 t/ha in 1989.

In Peninsular Malaysia, cocoa yield is expected to improve for most of the estates in 1989. The yield for the estate in Kelantan which was submerged in flood water will, however, decline.

CONCLUSION

Although the cocoa yield for most of the estates has improved markedly, there is still considerable room for improvement. Most of the estates in Sabah will suffer some setback in 1989 because of the unfavourable weather and VSD. However, this should not deter us from working towards our goal of yield improvement.

Ooi, L.H.

ANALYSIS OF RUBBER YIELDS OVER THE PAST THREE YEARS

The weighted mean rubber yield per hectare per year for the estates under AAR service has increased from 1664 kg/ha/yr in 1985/86 to about 1780 kg/ha/yr (Table 1)) which is considered satisfactory. Yield per tapper remained at an average level of 23 kg over this period.

Table 1: Mean rubber yields (weighted) for estates under AAR service

	1985/86	1986/87	1987/88
Yield p.ha(kg)	1676	1785	1775
Yield p.tapper(kg)	23	23	23
No. of estates	63	66	66

N.B.Financial year mainly October to September. Some July to June.

The number of estates and their percentage distribution in the various yield classes over the past three years are shown in Table 2 :-

Table 2: Number and percentage of estates under following yield classes

Yield/ha (kg)	1985/86	1986/87	1987/88
< 1500	16 (26%)	7 (10%)	10 (15%)
1501-1800	29 (46%)	31 (47%)	30 (46%)
1801-2000	16 (25%)	17 (26%)	14 (21%)
> 2000	2 (3%)	11 (17%)	12 (18%)
Total	63(100%)	66(100%)	66(100%)

Yield/tapper (kg)	1985/86	1986/87	1987/88
< 20	16 (25%)	16 (24%)	19 (26%)
21-24	29 (46%)	24 (36%)	30 (48%)
25-28	16 (26%)	23 (35%)	12 (18%)
> 29	2 (3%)	3 (5%)	5 (8%)
Total	63(100%)	66(100%)	66(100%)

N.B. Financial year mainly October to September. Some July to June.

The bulk of estates (approx. 46%) maintained a fair to satisfactory yield range (1501-1800 kg/ha/yr) over the 3-year period. However since 1987/88 there were more estates with satisfactory to high yields (1800 to > 2000 kg/ha/yr) and fewer estates with poor yield (< 1500 kg/ha/yr).

For the past three years, yield per tapper (YPT) has been rather disappointing, with most of the estates (> 60%) attaining YPT of average (21-24 kg) to below average (< 20 kg) levels. Only 26% of the estate attained satisfactory to high yield per tapper (25 to > 29 kg) in 1987/88.

Table 3 shows the mean rubber yields between states. The states/regions with satisfactory/high yields per hectare (> 1800 kg/ha/yr) over the last three years or so were Kedah, North Johore and Pahang. Kelantan estates have improved over this period to achieve 1853 kg/ha/yr in 1987/88.

Table 3: Mean rubber yields (kg weighted) between states for estates under AAR service

	1985/86		1986/87		1987/88	
	Yield/ ha (kg)	Yield/ tapper (kg)	Yield/ ha (kg)	Yield/ Tapper (kg)	Yield/ ha (kg)	Yield/ tapper (kg)
State						
Kedah	1846	24 (10)*	1902	24 (11)*	1839	23 (11)*
Perak	1598	22 (14)	1690	23 (14)	1649	22 (14)
Selangor	1659	23 (8)	1820	24 (9)	1657	22 (9)
N. Sembilan	1695	24 (6)	1720	23 (7)	1733	23 (7)
Malacca	1508	24 (3)	1395	21 (3)	1549	21 (3)
Johore -JH1#	1692	22 (4)	1898	24 (4)	1908	22 (4)
JH2	1453	24 (1)	1490	24 (1)	1341	25 (1)
JH3	1573	21 (3)	1668	20 (3)	1727	19 (3)
Johore Mean	1644	22 (8)	1814	22 (8)	1842	22 (8)
Pahang	1749	26 (6)	1887	28 (6)	1899	27 (6)
Kelantan	1532	19 (8)	1703	21 (8)	1853	22 (8)
Mean(weighted)	1676	23 (63)	1785	23 (66)	1775	23 (66)

Ref: * No. of estates

\# JH1 = North Johore, low rainfall, 2 dry periods/yr.
JH2 = South Johore, high rainfall, no dry period
JH3 = South/Central Johore, mod. rainfall, 1 to nil dry period

The main factors contributing to the satisfactory/high yield in Kedah estates were the normally good refoliation, negligible secondary wintering or rain interference and thus good tapper out-turn. Rubber in Kelantan often benefitted from good refoliation and minimum secondary wintering too although monsoonal months towards the end of the calender year caused serious yield reduction. Another reason for the satisfactory/high yield performance for rubber in Kelantan, North Johore and Pahang is the increasing percentage of the rubber in their prime bearing age, planted in the 1970's (Table 4).

Table 4 : Percentage distribution by age of rubber under AAR service

State	Ha	1950s'	1960s'	1970s'	1980s' (mature)	1980s (immature)
Kedah	8936	7%	57%	23%	1%	12%
Perak	6064	0%	39%	34%	6%	21%
Selangor	5912	1%	36%	29%	12%	22%
N.Sembilan	6365	2%	53%	11%	16%	18%
Malacca	1563	0%	42%	29%	20%	9%
Johore						
JH1	4265	2%	29%	41%*	8%	20%
JH2	78	0%	0%	81%	19%	0%
JH3	1504	0%	72%	28%	0%	0%
Pahang	5316	0%	13%	62%*	3%	22%
Kelantan	4675	1%	31%	40%*	4%	24%
Total	44678	2%	41%	42%	32%	18%

* High percentage of prime rubber

Estates in Perak, Selangor, Central-South Johore (JH3) and Negeri Sembilan generally had moderate yields, ranging from around 1650 to 1750 kg/ha/yr. Canopy densities in Perak, Selangor and Central-South Johore were often less than satisfactory in view of the prevalence of *Colletotrichum* SLF (*secondary leaf fall*) due to the high rainfall in these areas. The Negeri Sembilan rubber areas are those around Bahau district, where low rainfall, secondary wintering and predominance of 1960s' rubber (mostly with below average stand) depressed yield to some extent.

Average yield from the few estates in Malacca and South Johore (JH2) had not been satisfactory, ranging from around 1350 to 1550 kg/ha/yr. The main factors were SLF's (*Oidium* in Malacca, *Colletotrichum* in South Johore), moisture stress (Malacca), occurrence of secondary wintering, and predominance of 1960s' rubber with declining yields.

Yield per tapper has been highest from estates in the Pahang region at 26 to 28 kg/tapper, which could be due to the better turgor pressure from the hilly fields with possibly cooler temperatures or lower sunlight hours. Stands in these estates were generally low as well, resulting in bigger girthed trees which could also possibly bring about high yield per tapper. Yields per tapper from the other regions are in the 20 to 23 kg range, which implies that there is room for improvement.

Ong T.S.

1988 AND 1987 OIL PALM YIELDS REVIEW

The 1988 and 1987 oil palm yields for the main contrasting climatic regions in Peninsular Malaysia and Sabah (Tawau Region) for different palm ages were reviewed. The main regions were:

Region 1– No distinct dry season (Johore, South Kedah, Perak and Selangor)
Region 2– Short regular dry season (Negeri Sembilan)
Region 3– Prolonged distinct dry season (Kelantan and Central Kedah)
Region 4– Sabah (Tawau region)

A representative number of sizable oil palm estates were chosen for each region to compare the yield performance of palms of different ages in 1988 and 1987 as presented in Table 1. The mean yields of the palms of different ages for the various regions in 1988 and 1987 were plotted in Fig. 1.

a) Regional Yield Trends

The overall 1988 yields were better than those of 1987 as recorded in three out of the four regions reviewed. The increase in bunch (FFB) production was more evident in Region 1 (1.0 t/ha) and Region 4 (2.4 t/ha). In Region 1, the yield improvements were mainly in the 1980-1972 plantings whereas in Region 4, the improved yields were predominantly in the 1983-1978 plantings which also covered very extensive hectarages. Region 2, however, had generally poorer yields in 1988. This was attributed primarily to considerable yield decline in the older areas. In Peninsular Malaysia, Region 1 outyielded Region 2 and Region 3 for both years. As for Region 4, in Sabah, the mean overall yields was also superior to Region 2 and Region 3 and can be equivalent, if not, better than Region 1, if the rate of yield improvement is sustained.

b) Yield Pattern In Relation To Palm Age

In both 1988 and 1987, yields were generally highest for the plantings ranging 6-16 years old, whereas the younger and older palms had predominantly lower yields. This pattern was similar in all the four regions.

However, the above yield profile should not be considered as an inevitable permanent feature. A better head-start can be achieved during the early years of maturity with proper nursery palm selection, sufficiently high fertilizer inputs right from field planting and good legume cover establishment, as reflected by some early high yielding fields. As for the much taller older plantings difficulty in harvesting, delayed pruning rounds and interpalm competition for light and soil moisture are the probable causes of yield decline. Hence, for such areas, efficient crop recovery and palm thinning of the more competitive palm situations are required to uphold satisfactory yield levels.

c) 1989 and 1990 Yield Forecast

The 1989 and 1990 FFB yields for Region 1 and Region 4 should continue to be promising in view of the favourable rainfall received during 1987 and 1988. In Region 4, February (46 mm) and March 1987 were fairly dry (71 mm) but the subsequent yield depression effect would not extend beyond the first quarter of 1989.

As for Region 2, February 1987 was extremely dry and would favour the emergence of male inflorescences leading to poor yields during the three months of 1989. Thereafter the yields should be fairly satisfactory as prompted by the better monthly rainfall distribution in 1988.

In Region 3, the situation is expected to be similar to Region 2. This is again due to the marked dry season in January (77 mm) and February 1987 (6 mm), followed by improved rainfall pattern in 1988.

Cheong S.P.

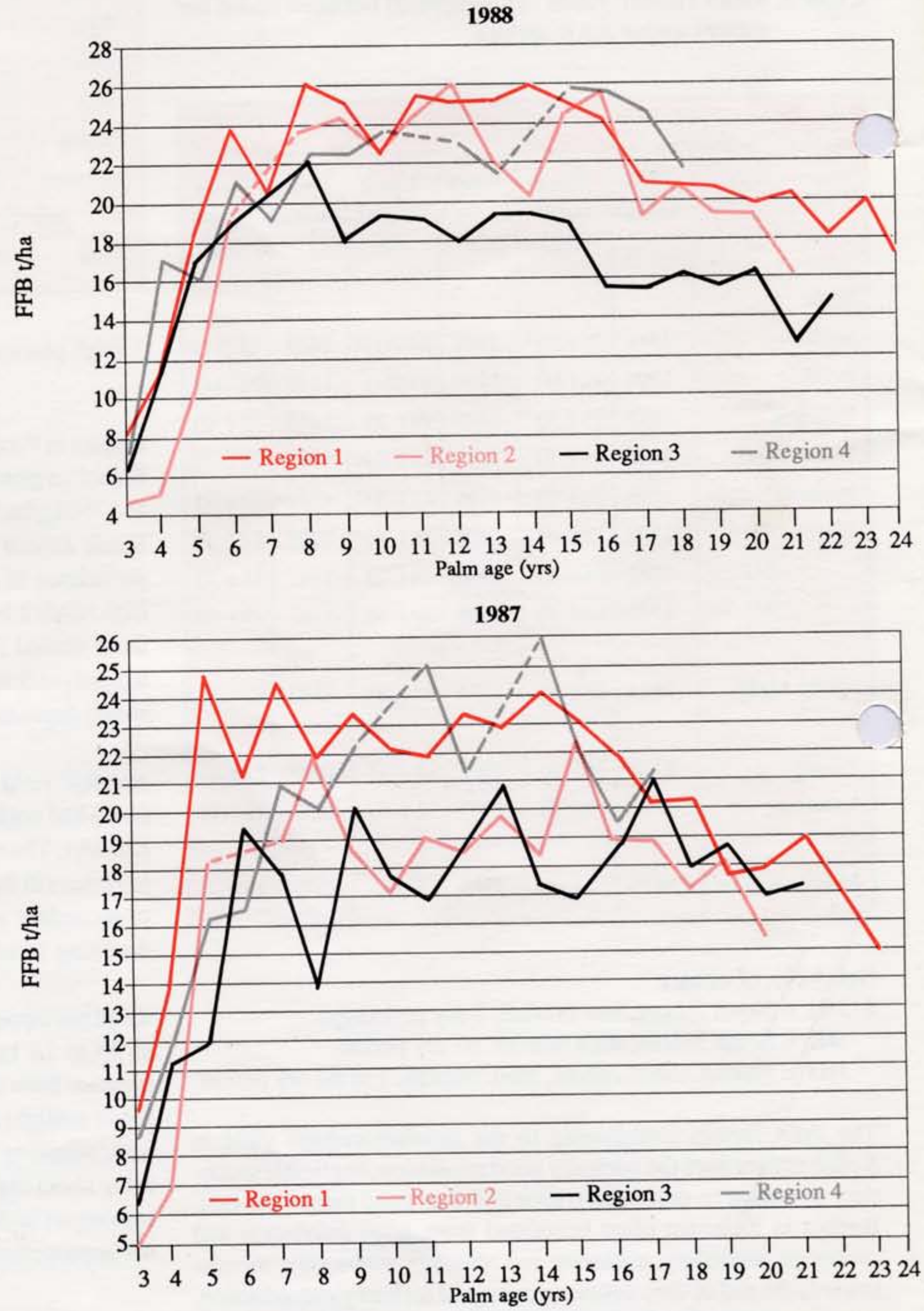

Fig. 1 : 1988 and 1987 oil palm yields of the main climatic regions in P. Malaysia and Sabah (Tawau) for different palm ages.

Table 1 : 1988 oil palm yields (t/ha) of the main climatic regions in P. Malaysia and Sabah (Tawau) palms of diffirent palm ages

Region 1. No distinct dry season

Palm age (yrs)	1988 FFB yields			1987 FFB yields		
	Ha	Range	Mean	Ha	Range	Mean
3	559	5.3 - 19.8	8.1	198	4.1 - 12.4	9.7
4	168	8.3 - 19.1	11.6	358	5.6 - 20.2	14.2
5	356	7.1 - 20.4	18.5	175	21.7 - 34.6	25.1
6	169	23.7 - 24.1	24.0	678	12.3 - 34.5	21.4
7	678	11.4 - 28.2	20.5	442	19.9 - 38.9	24.8
8	442	23.6 - 36.4	26.3	149	17.4 - 23.2	22.2
9	149	21.3 - 26.2	25.2	593	21.4 - 30.2	23.5
10	593	19.3 - 32.5	23.0	339	20.9 - 25.8	22.4
11	339	23.6 - 29.5	25.6	1394	18.5 - 27.6	22.0
12	1394	22.1 - 27.5	25.0	1503	20.3 - 24.3	23.5
13	1503	21.4 - 31.1	24.9	1853	18.0 - 24.1	23.0
14	1853	18.9 - 31.7	26.0	2104	17.2 - 29.9	24.4
15	2104	19.3 - 28.3	25.0	1323	20.6 - 23.7	23.1
16	1323	18.1 - 25.7	24.1	453	15.6 - 25.2	22.0
17	453	14.8 - 21.2	20.8	76		20.4
18	76		20.5	662	15.0 - 24.2	20.5
19	662	14.2 - 28.4	20.4	1166	16.6 - 21.2	17.9
20	1166	15.7 - 24.1	19.8	974	15.4 - 20.3	18.1
21	974	16.1 - 23.3	20.4	368	15.1 - 19.7	18.8
22	368	15.0 - 20.1	18.2	976	16.5 - 17.6	17.0
23	976	18.4 - 20.9	19.8	287	11.5 - 17.3	15.2
24	287	14.4 - 18.1	16.7			
Total	16592		22.4	16071		21.4

Region 2. Short regular dry season

Palm age (yrs)	1988 FFB yields			1987 FFB yields		
	Ha	Range	Mean	Ha	Range	Mean
3	56	4.4 - 8.8	4.6	78		5.0
4	78		5.0	50		7.0
5	50	-	10.6	59		18.3
6	59	-	19.2		-	
7		-		91	16.6 - 22.0	19.2
8	91	20.6 - 27.0	23.6	220	20.0 - 23.4	22.1
9	220	22.8 - 25.5	24.5	272	14.2 - 21.8	18.7
10	272	20.1 - 25.1	22.8	187	16.9 - 25.4	17.5
11	187	24.4 - 26.9	24.6	45		19.2
12	45		26.0	97	18.3 - 21.9	18.6
13	97	19.1 - 22.4	22.1	206	14.3 - 22.4	19.9
14	206	19.8 - 22.3	20.6	411	14.6 - 20.8	18.4
15	411	19.8 - 27.3	24.6	156	22.4 - 22.7	22.6
16	229	22.5 - 26.6	25.3	499	14.7 - 23.8	19.1
17	499	13.7 - 24.6	19.4	1159	14.7 - 24.1	19.0
18	1159	13.0 - 24.8	20.4	1155	14.8 - 20.9	17.6
19	1155	13.8 - 22.1	19.3	432	15.8 - 20.3	18.2
20	432	15.2 - 22.3	19.3	49	15.5	15.5
21	49	15.9	15.9			
22						
23						
24						
Total	5295		18.9	5166		18.4

Region 3. Prolonged distinct dry season

Palm age (yrs)	1988 FFB yields			1987 FFB yields		
	Ha	Range	Mean	Ha	Range	Mean
3	306	3.7 - 8.9	6.3	216	1.3 - 7.3	6.6
4	220	3.2 - 17.6	11.6	156	6.6 - 13.9	11.3
5	156	11.3 - 18.9	17.1	120	10.3 - 16.2	11.9
6	120	13.5 - 23.5	19.0	224	16.1 - 20.0	19.5
7	224	17.0 - 23.3	20.6	261	14.0 - 20.9	17.9
8	261	20.8 - 23.7	22.2	195	12.7 - 18.8	14.2
9	195	12.8 - 23.2	18.3	524	14.2 - 23.7	20.4
10	524	15.2 - 23.6	19.4	499	13.3 - 20.8	17.9
11	499	16.5 - 24.7	19.0	711	14.6 - 19.9	17.0
12	711	16.8 - 22.2	17.9	219	14.4 - 23.6	18.7
13	219	16.6 - 24.0	19.4	419	9.7 - 22.1	20.9
14	419	9.4 - 24.5	19.4	216	11.4 - 20.7	17.4
15	216	10.5 - 24.6	18.9	153	11.7 - 17.1	16.9
16	153	14.5 - 15.6	15.6	148	10.6 - 21.0	18.7
17	148	11.0 - 16.9	15.6	235	21.0 - 21.5	21.0
18	235	15.1 - 16.7	16.2	505	17.4 - 18.9	18.2
19	505	14.1 - 17.5	15.6	402	18.6 - 18.9	18.7
20	402	15.5 - 16.7	16.3	341		16.9
21	341		12.5	536	13.8 - 21.2	17.2
22	536	13.6 - 16.8	15.1			
23						
24						
Total	6390		16.8	6080		17.6

Region 4. Sabah (Tawau region)

Palm age (yrs)	1988 FFB yields			1987 FFB yields		
	Ha	Range	Mean	Ha	Range	Mean
3	91	7.4	7.4	747	8.7	8.7
4	793	13.6 - 17.2	17.0	885	11.3 - 13.7	12.0
5	885	14.8 - 20.8	16.2	862	15.8 - 17.7	16.6
6	862	18.7 - 22.1	21.0	1177	16.5 - 22.9	16.9
7	1177	18.9 - 31.5	19.4	1056	19.9 - 25.5	21.2
8	1056	20.4 - 25.0	22.6	3347	18.4 - 21.8	20.3
9	3347	19.2 - 24.3	22.6	2030	20.6 - 27.4	22.6
10	2030	21.9 - 26.3	23.9		-	
11		-		318		25.3
12	318	23.3	23.3	434		21.3
13	434	21.6	21.6		-	
14		-		248		25.9
15	248	25.6	25.6	234		22.3
16	234	25.3	25.3	241		19.7
17	241	24.2	24.2	20		21.4
18	20	21.4	21.4			
19						
20						
21						
22						
23						
24						
Total	11736		21.5	11599		19.1

THE COST OF PRODUCTION EQUATION IN COCOA

The production cost of cocoa in a well-run plantation system may be simply defined by the following equation :-

Production cost ($/kg)

$$= \frac{\text{Fixed cost (\$/ha)}}{\text{Yield (kg/ha)}} + \text{Variable cost (\$/kg)}$$

Where :-

1) fixed cost
   = general charges/indirect cost + upkeep cultivation cost

2) variable cost
   = harvesting & collection cost + manufacturing cost

Looking at the equation, it is obvious that a simultaneous reduction in the fixed and variable costs and improvement in yield will produce the best results.

This is easier said than done as the level of inputs has a direct bearing on the yield. It is often not possible for one to reduce inputs and at the same time improve yield. Any withdrawal of essential inputs will more likely have adverse effects on the yield. More often than not the production manager has to strike a delicate balance between the two.

This being the case, where does one draw the line ?

The problem is probably best tackled by studying the following hypothetical cases which are more likely to occur in actual practice :-

1) **Case 1**
   Increasing the fixed cost inputs to obtain higher yield.

2) **Case 2**
Partial withdrawal of fixed cost inputs leading to lower yield.

3) **Case 3**
Maintaining the existing inputs but making special efforts to apply the inputs correctly particularly with regard to rates, timing and placement and also minimise wastage and thereby improving the yield.

4) **Case 4**
Partial withdrawal of fixed cost inputs. Yield maintained through maximal use of the reduced inputs.

The scenarios are summarised in Table 1.

Table 1 : Effects of yield improvement and reduction of inputs on the profitability of cocoa

Particulars	Cocoa dry bean at $4.00/kg			
	Case 1	Case 2	Case 3	Case 4
Assumptions				
Initial fixed cost ($/ha	1800	1800	1800	1800
% increase in fixed cost	20	(20)	0	(20)
Final fixed cost ($/ha)	2160	1440	1800	1440
Variable cost ($/kg)	0.70	0.70	0.70	0.70
Initial yield (kg/ha)	1000	1000	1000	1000
% increase in yield	20	(20)	20	0
Final yield (kg/ha)	1200	800	1200	1000
Production cost				
Initial ($/kg)	2.50	2.50	2.50	2.50
Final ($/kg)	2.50	2.50	2.20	2.14
Reduction in cost ($/kg)	0	0	0.30	0.36
Reduction in cost ($/ha)	0	0	360	360
Gross revenues				
Initial ($/ha)	4000	4000	4000	4000
Final ($/ha)	4800	3200	4800	4000
Increase ($/ha)	800	(800)	800	0
Profit				
Initial ($/ha)	1500	1500	1500	1500
Final ($/ha)	1800	1200	2160	1860
Increase ($/ha)	300	(300)	660	360

Note :
1. Figures in brackets are negative
2. The cases are best compared in pairs in the following way :-
   a) Case 1 with Case 2 and
   c) Case 3 with Case 4

Case 3 is obviously the ideal case while Case 2 should be avoided as far as possible.

By pairing the cases for comparison i.e. Case 1 with Case 2 and Case 3 with Case 4, it is obvious that it is more profitable to focus our attention on yield improvement either by increasing the inputs and/or by improving the efficiency of the existing inputs.

This is because an improvement in yield will not only reduce the unit cost but also generate more revenue and hence higher total profit.

On the other hand, a reduction in essen inputs will at best reduce the unit cost only i.e. if there is no reduction in yield.

Moreover, the cost of inputs in our plantation system are already very closely controlled and scrutinised. There is really not much room for cut-back. Any significant withdrawal of inputs will likely affect the yield adversely, leading to higher unit cost and reduced profits.

There is little doubt that **more effective use of inputs and improvement in yield** are the best policy for our plantations.

Ooi L.H.

FERTILIZER BRIEFS

The analysis of plant, soils and fertilizers is carried out by AAR Chemistry Section. Each year, more than 6000 leaf samples, 3000 soil samples and 1000 fertilizer samples are routinely tested for their nutrient contents in the course of manuring recommendations and fertilizer quality checks.

To ensure that the laboratory results are accurate and consistent, the Chemistry Section participates regularly in both local and international cross-checks in all aspects of plant, soil and fertilizer testing.

Overall performance in these cross-checks are generally good and anomalous results are seldom encountered. All the leaf and soil samples tested in the laboratory come from AAR while fertilizer samples come from the estates.

Lately fertilizer analysis is assuming more importance on account of the sources of supply which appear to vary in quality. This paper highlights two fertilizer materials from China which are widely used in AAR advisory estates.

Kieserite from China

Kieserite is the natural mineral form of magnesium sulphate ($MgSO_4$) and the traditional sources are from German potash mines. The product from West Germany usually contains 26% MgO while that from East Germany contains slightly lesser MgO, about 25%. Natural kieserite is only slightly soluble in cold water but dissolves in hot water and in acid as shown below.

		Remarks
Acid soluble MgO	= 24.5%	Tested by using 10g kieserite
Hot water soluble MgO	= 23.7%	in 100 ml solution.
Cold water soluble MgO	= 2.5%	

Lately owing to the rising cost of German products, importers have turned to China as a cheaper source of kieserite. Technically speaking, the so-called China kieserite is not a natural mineral but a by-product of the refractory industry whereby the lower grade magnesite or magnesium carbonate is treated with sulphuric acid to form magnesium sulphate as shown below.

$$MgCO_3 + H_2SO_4 = MgSO_4 + H_2O + CO_2$$

Solubility of the product depends on how complete the reaction is taken since magnesium sulphate is easily soluble in cold water unlike the raw material magnesium carbonate which is not water soluble. Early batches of China kieserite tested in 1986 were about 50% water soluble implying incomplete reaction in manufacture. With experience the product improved to give 70% solubility in 1987. Lately, the China kieserite used by the estates are 80-90% water soluble as shown below:

Year of Sample	Total Mg0 content	Water soluble Mg0 content	Ratio of water sol. Mg0 to total Mg0(%)
1986	32.3	17.3	53.6
1987	30.6	21.7	70.7
Jan.'88	29.4	26.8	91.2
Mar.'88	28.1	25.1	89.3
Nov.'88	28.1	25.3	90.0
Nov.'88	28.5	24.8	87.0
Dec.'88	28.7	23.5	81.2

Agriculturally, China kieserite serves as a readily available source of magnesium (Mg) and sulphur (S).

Ammonium Chloride from China

Method of Production

Most ammonium chloride used in India, China and Japan for fertiliser purposes are by-products of the dual salt process or Modified Solvay process. In the Solvay process of making soda ash, brine is saturated with ammonia gas and carbon dioxide (obtained by heating limestone) is bubbled through the solution whereby reaction occurs as shown below:-

$$NaCl + NH_3 + CO_2 + H_2O = NaHCO_3 + NH_4Cl \text{ .... (1)}$$

The sodium bicarbonate ($NaHCO_3$) is precipitated, filtered and ignited to give soda ash (Na_2CO_3) and carbon dioxide (CO_2) which is re-used. Ammonium chloride (NH_4Cl) is heated with lime to regenerate NH_3 for re-use.

In the Modified Solvay process, the ammonium chloride is not heated with lime but recovered instead. This is done by ammoniating the ammonium chloride solution, cooling below 15°C and salting out by adding solid sodium chloride, using the common ion effect. The economics of this process of producing soda ash is most favourable when carried out adjacent to an ammonia plant.

The ammonium chloride produced by this method particularly when granulated or produced in coarse crystal form is reported to have good physical properties and typical analysis is shown below:-

Nitrogen as % N (minimum)	= 25%
% Sodium as Na	= 0.6%
% Carbonate as CO2	= 0.5%

Properties of China Ammonium Chloride

Most of the ammonium chloride fertiliser (AC) used now in this country comes from China. The most common problem with China AC appears to be caking and although this problem has been highlighted to the suppliers, it still occurs frequently and incur additional breaking charges. Occasionally, the problem is aggravated by high moisture content due to incomplete drying by the manufacturer or exposure to wet weather.

Besides causing caking, the presence of water also releases ammonia from the fertiliser due to reaction with impurities of residual sodium bicarbonate, a reversal of Equation 1.

$$NaHCO_3 + NH_4Cl = NaCl + NH_3 + CO_2 + H_2O$$

(residual impurity)

This makes the fertiliser smell strongly of ammonia but the N loss is limited by the amount of residual sodium bicarbonate in the fertiliser which is generally very low. However the odour of ammonia is unpleasant and it can make working conditions in the fertiliser store unpleasant.

An instance of widespread caking, high moisture and ammonia release was encountered during the sampling of two shipments of China AC from Port Klang in late 1988 and test results are shown below:-

Date of shipment	Moisture (%)	Nitrogen (%)	Sodium (%)	% N on dry basis
20/11/88	3	4.5	0.4	25.3

Of course not all the AC from China is so bad. In this case the importer claimed that the factory was new and not familiar with AC production compared with the established factories as shown by the results of a superior batch of AC tested recently at AAR.

Date of shipment	Moisture (%)	Nitrogen (%)	Sodium (%)
Jan.'89	0.1	25	0.7

It appears necessary therefore to scrutinize closely the specifications of ammonium chloride offered for sale and to monitor supplies from new sources or shipments to ensure conformity to the specifications. Otherwise the projected benefit with use of this fertiliser will not be met and additional problems in handling and applications could be encountered on the plantations.

Chan K.S.

AAR NEWS

New Office Complex

There will be much physical changes seen at the AAR office complex area for the next few months. Firstly, the area where the Bujong Division of Coalfields Estate has its assistants bungalow and line-site will be taken up by the N-S Highway which runs from Port Klang to Tanjong Malim. Secondly, AAR will be building a new, more integrated office complex in the oil palm area opposite the current complex of dispersed bungalows.

Staff Changes

AAR's Senior Agronomist for oil palm, Teoh Kok Choon has tendered his resignation. A M. Agric. Sc. graduate from Queensland University, he served as a cocoa agronomist with MARDI for six years, and as an oil palm agronomist in HRU for six years before joining AAR as head of the oil palm section in 1986. He has been an active researcher and has contributed much to the company and industry in the field of oil palm agronomy. He and his family will be leaving for Australia to seek a new life. He will leave behind many good friends at AAR and in the advisory estates who will wish him all the best.

Saw Eng Guan, joined AAR on April 1, 1989 as a programmer, with the initial brief to develop a database for all the crops involved in AAR's research and advisory service. Prior to this, he was a research assistant (programming) at PORIM for five years.