AA RESEARCH NEWS

EDITORIAL

Most estates proudly pin their coloured digitised estate maps on their notice board for display to visitors. The work of this impressive display may be attributed to Tey Seng Heng and Patrick Ng and their team who diligently churn out some 3500 updated maps yearly to estates. Tey Seng Heng has successfully obtained his Masters degree in Remote Sensing and GIS and has kindly consented to update readers on the uses of geographic information technologies in plantation crops.

Tan Cheng Chua et. al., presented the paper 'Experiences and lessons from oil palm clonal evaluation trials and commercial plantings' at the 2003 PIPOC conference. Results from the more recent 1997 and 1998 trial plantings indicate clones to mostly outyield their respective DXP controls by 18-30 percent in total oil yield, auguring well for AAR clones. The slightly abridged version of their paper is reproduced here for your easy reading.

Rubber planters (and rubber agronomists), please stand up and be counted! The rubber price has shot through the roof and should stay high for the next decade.

Inside this issue:

Application of Geographic Information Technologies in Plantation Crops

By Tey Seng Heng

Introduction

Recognizing the need to maintain accurate estate maps to facilitate site-specific agronomic and management inputs for high yields, it has become standard practice for Applied Agricultural Research (AAR) to produce and maintain digital maps of estates using the Global Positioning System (GPS) and Desktop Geographic Information System (GIS) since 1993. Besides basic mapping and quick land area verification, there are many other potential applications of these technologies which are useful to our plantations. Another useful tool available is Remote Sensing (RS). These systems are briefly discussed below.

GIS

GIS is defined as an information system that is used to input, store, retrieve, manipulate, analyse and output geographically referenced data, in order to support decision making for planning and management of land use, natural resources, environment, transportation, urban facilities and other administrative records.

GIS was already in use about 30 years ago (Berry, 1995) to handle geographic data and spatial information for the planning and management of resources.

In the mid-1980s, popular digital-based GIS system like ESRI's Arc/Info, Intergraph's GeoMedia etc. were only used by large government bodies and private organizations for environment management or urban and regional planning due to high investment costs. With the advancements in desktop personal computer and Windows-based operating system and software, a more affordable scaled down GIS system generally known as Desktop Mapping/GIS is currently available. This system is fast becoming popular among small organizations and individual users engaged in a wide range of applications, including resource planning and facilities management, environment modeling, market forecasting and precision farming etc. For example, businesses can track customer locations to maximize delivery routes or to simply decide where to place their new offices or stores. Scientists can also use GIS to manage sensitive wildlife habitats or track animal movements while healthcare specialists can monitor the spread of infectious diseases with the system. MapInfo, ArcView, ArcGIS, WinGIS are among the popular Desktop Mapping/GIS software that are widely used in Malaysia today.

GPS

The functions of GIS is greatly enhanced with the introduction of GPS, a navigation system first developed by United States Department of Defense in the late 1950s for military purposes (Berry, 1995). Currently there are as many as 27 GPS satellites, circulating in orbits at about 20,200 km above the earth and constantly sending radio signals for the GPS receivers to calculate accurate positions (in latitude and longitude), day and night, in any weather condition, anywhere on the globe.

Comparable to the United States GPS is a Soviet space-based navigation system known as The Global Navigation Satellite System (GLONASS) that is currently managed by the Russian Space Forces for the Russian Federation Government. Both the GPS and GLONASS share the same principles in the data transmission and positioning methods but the latter consists of only 21 satellites that operate in circular 19,100 km orbits. Potential uses of GPS will further be enhanced with the launch of a more sophisticated civilian-controlled global navigation satellite system "Galileo" by the Europeans in 2008. The Galileo system will consist of 27 operational and 3 active 'spare' satellites in three circular medium planes in 23,616 km altitude above the earth.

Currently GPS receivers are mostly built with more than 8 receiving channels to utilize signals from GPS and GLONASS either individually or together for greater accuracy and coverage. In the near future when Galileo is fully operational, most GPS receivers will likely be built with a minimum of 24 receiving channels to acquire signals from any of the satellites in any combination for greater accuracy, flexibility and a wider range of applications.

Remote sensing (RS)

RS is a practice where information on the earth surfaces is derived from images acquired from an overhead perspective, using electromagnetic radiation in one or more regions of the electromagnetic spectrum, reflected or emitted from the earth's surface (Campbell, 1996). It greatly enhances our ability to collect large amount of spatial data on the earth surfaces over a short period of time.

From the agriculture point of view, conventional ground assessment of plant health is confined to only variations in sizes and visible colours that our human eye can differentiate. Our ability to assess is also restricted by time constraint and the limited number of leaf and soil samples that can be analyzed. The plant chlorophyll molecules absorb as much as 70% to 90% of the blue and red lights but reflect much more of the green light and cause us to see the dominant reflection of green as the colour of living vegetations. One of the greatest advantages of RS in agriculture is the presence of more pronounced differences in reflectivities of plant species, leaf water content, leaf canopy structure and leaf surface temperature in the invisible near infrared, far infrared and microwave regions of the electromagnetic spectrum. This provides an opportunity for us to objectively discriminate vegetation classes and variations in growth status beyond our naked eye.

Many satellites, among them IKONOS and QuickBird, are in operation to support the use of RS by governments, organizations and individuals around the world. More new and advanced satellites are constantly being launched. The usefulness of RS may be seen in the example of a 61 cm-ground-resolution image captured with the imaging system onboard the latest Quickbird satellite at 450 km altitude above the earth, where a Suzuki jeep can be readily differentiated from a bigger Toyota Land Cruiser. Similarly RS can be usefully adopted for the management of our plantation crops.

AAR Desktop Mapping & GIS

As the required tools i.e. GPS receivers, GIS software and satellite imagery etc. are becoming more affordable and readily available in Malaysia, more local plantation research organizations are now paying attention to the applications of these technologies. Some of the practical and useful applications developed at AAR over the past eight years are briefly discussed below.

1. Production of Digital Estate Map and Verification of Land Area

The basic use of GPS has been confined mostly to the production of digital field maps and quick land area verification in the estates. At AAR, more than 200 estates covering over 200,000 ha. of planted areas have been mapped over the past 8 years and more than 3500 pieces of maps of varying scales and sizes are printed annually for use by estates.

Accuracy of the affordable Mapping-grade Differential GPS (DGPS) has improved from around 10 m in early 1990 to about 2 m currently, making it possible for planters and contractors, to quickly verify land clearing activities with GPS for accurate payment or compensation purposes (Figure 1).

2. Utilization of Available Spatial Data

In Malaysia, most of the developed estates should already have their perimeters surveyed by licensed surveyors prior to development. Most of the surveyed maps should have been plotted with a local earth coordinate system either in Cassini State Plane or Rectified Skewed Orthomorphic (RSO) Projection. By utilizing these geo-referenced coordinates on the maps, precise location of the estates can usually be accurately referred to within 5 m accuracy using a desktop mapping GIS software like MapInfo. This has increased our ability to retrieve much more useful spatial data from the readily available geological maps, topographical maps, soil maps, land-use maps etc. of varying scale and format with great precision for reference (Figure 2).

3. Visualization of Spatial Data

Important data such as yield (Figure 3) and rate of fertilizer input, palm canopy size and vigour etc. that vary across fields can usually be better visualized if displayed thematically in a spatial format than in a tabular format. One of the most useful functions of GIS is to handle and display these important spatial data for analysis but this application has yet to be exploited due to probably the lack of computer facilities, knowledge in GIS and organized digital data acquisition and storage methods in the plantation sector.

4. Differentiation of Large Fields

GIS and GPS have also been utilized for the differentiation of large fields into smaller management units of practical sizes based on soil type, terrain condition, palm age and road network etc. to allow the maximization of yield productivity through variable agronomic and management inputs. By utilizing these technologies, the available soil, contour and road maps etc. can be conveniently superimposed and overlaid to allow this important task to be satisfactorily performed.

5. Alignment of Drain and Road

Combining the use of a 'Total Station', an accurate digital altimeter and a GPS in Carrier-phase data logging mode, ground elevation data can be fairly quickly and accurately collected for the production of a Digital Terrain Model (DTM) containing digital data that represent the relief of the ground surfaces. This exercise has been performed to a certain degree of success with the production of useful ground relief maps that can enhance our ability to plan for effective drainage scheme and the alignment of main roads prior to construction. For low-lying areas that require proper drainage system, appropriate 'Rajah-line' and the positions of planting points often can also be fairly satisfactorily pre-determined in advance for planning purposes using GIS, accurate GPS receivers and digital estate maps that are flexible in scale and size.

6. Mobile Map

GPS is often associated with tracking of movable objects like people, animals and vehicles etc. Tourists are already using hand-held PDA and bluetooth enabled GPS receiver to navigate through cities and locate their destinations all over the world.

However, this useful function of GPS can only be fully exploited by those who have access to accurate digital maps (Figure 4). At AAR, digital maps have already been produced for most estates and are readily available for use by those who have equipped themselves with the required tools i.e. a PDA, a CF (Compact Flash) GPS receiver and of course a suitable mobile mapping and navigation software like ArcPad and OzoExplorer.

A number of studies aimed to monitor vital field operations like fertilizer application and crop harvesting using the relevant technologies for the production of as `applied maps` and `yield maps` respectively to reveal variations in the rate of application and yield across fields is being pursued at AAR.

7. Assessment of Palm Growth

In order to achieve and sustain high yields, a detailed yield map should ultimately be produced to reveal low yielding palms for corrective purposes. However with current technologies and management constraints, it has not been feasible to produce a satisfactory yield map that can meet the requirements. Alternatively the differences in vegetative growth induced by spatial variations within a field can first be discriminated and the palms that are poor in canopy size and vigour can then be identified for inspection on the ground.

Satellite imagery has been utilized to assist in mapping and to identify the extent of flood prone areas (Figure 5). A few studies have also been initiated to evaluate the possibility of using remote sensing for palm growth assessments. Satellite imagery provides a synoptic view of estates that will allow all poorly grown palms to be quickly and thoroughly identified for site-specific inspection on the ground (Figure 6). Effort can then be focused on diagnosing the underlying causes of poor growth and appropriate corrective measures effectively implemented to improve vegetative growth and eventually yield of the affected areas.

Concluding Remarks

Support from government in the field of GPS surveying and mapping was apparent with the installation of MASS (Malaysia Active GPS System) that consists of 15 permanent GPS observation stations throughout the country. The project was funded by the government under the 7th Malaysian Development Plan to allow GPS users in Malaysia to have 24 hours access to GPS observational data and related products for GPS surveying and mapping purposes. Jabatab Ukur dan Pemetaan Malaysia (JUPEM) also launched a new Geocentric Datum of Malaysia (GDM 2000) in August 2003 in order to fit its mapping and survey products into the global geodetic framework that will allow unified and highly accurate mapping and surveying with GPS not only in Malaysia but throughout the world.

Another positive development in the related field was the establishment of The Malaysian Centre for Remote Sensing (MACRES) in August 1988. The centre is well equipped with a sophisticated ground receiving station in Termerloh, Pahang that can access and download satellite imagery directly from imaging satellites for the development and operational use of remote sensing, GIS and related technologies. Malaysian Remote Sensing Society (MRSS) had also been established in 1995 to, interalia, encourage and support education, research and development in remote sensing and GIS related technologies.

Locally there has been a number of workshops and seminars on precision farming organized to intensify effort and enhance scientific and technical knowledge in remote sensing in order to increase its benefits to the agricultural sector in the country. Latest development in the list was an agreement reached at a meeting of ACPA Promoters in Suwon, Korea in February 2003 to organize the Asian Conference on Precision Farming to be held biannually in rotation among member countries in Asia. The first will soon be held in Kuala Lumpur in May 2004.

The GIS, GPS and RS technologies provide an opportunity for utilizing and clearly visualizing the available information in ways that were not possible previously. AAR has been positive and supportive of research related to GIS, GPS and RS to further exploit the potential uses of these amazing technologies for the plantation industry.

References

Berry, J.K. (1995). Spatial Reasoning for Effective GIS. Fort Collins, Colorado. Campbell, J.B. (1996). Plant Science. In *Introduction to Remote Sensing*. The Guilford Press, New York, 4-5.

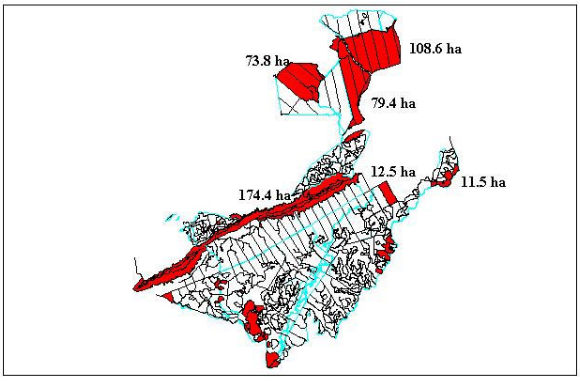


Figure 1. **With relative accuracy of better than 1 m, land areas cleared for planting or replanting in the estates can now be quickly and accurately verified using an accurate GPS receiver for planning or payment and compensation purposes.**

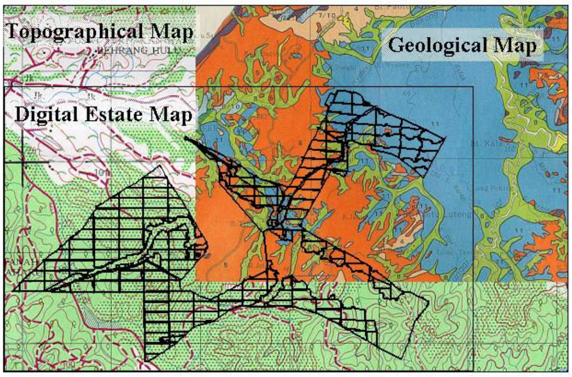


Figure 2. **Working with digital geo-referenced estate maps has increased our ability to utilize useful spatial data from the readily available geological maps, topographical maps, soil maps, land-use maps etc. of varying scales and format with great precision for reference.**

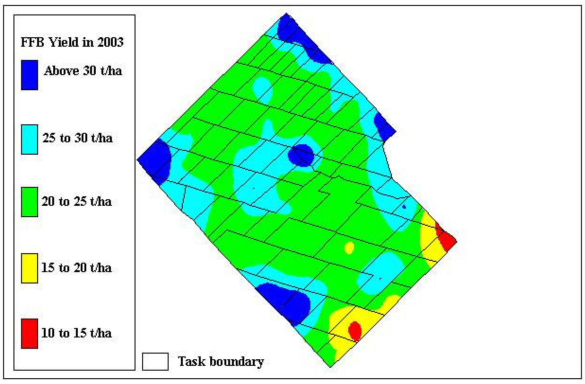


Figure 3.**Variation in yield within a field can better be visualized when displayed thematically in a spatial format than in the conventional tabular format (Figures in rows and columns).**

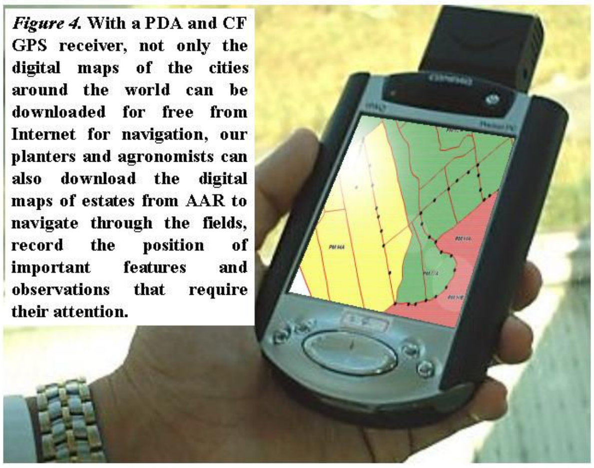


Figure 4. **With a PDA and CF GPS receiver, not only the digital maps of the cities around the world can be downloaded for free from Internet for navigation, our planters and agronomists can also download the digital maps of estates from AAR to navigate through the fields, record the position of important features and observations that require their attention.**

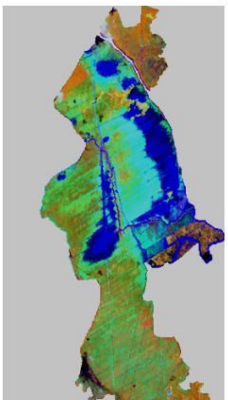


Figure 5. Assessment of damage caused by natural disasters like flood can now be carried out using affordable satellite imagery. The extent of flooding (in blue) and areas severely damaged by flood water (cyan) are readily detectable and can be quickly ascertained for evaluation.

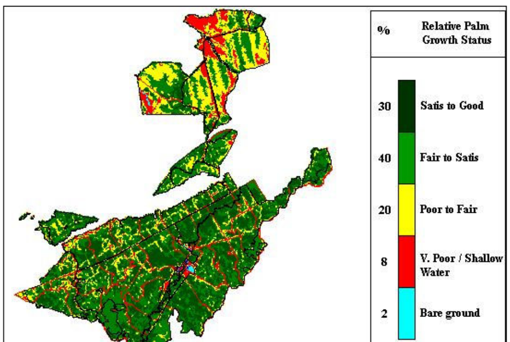


Figure 6. Palm vegetative growth may be assessed from a satellite image and classified according to their relative 'health' status. Efforts can then be focused to inspect the poorest areas and diagnose the underlying constraints for correction.

EXPERIENCES AND LESSONS FROM OIL PALM CLONAL EVALUATION TRIALS AND COMMERCIAL TEST PLANTINGS.

By Tan, C.C., Wong, G., Soh, A.C., Hor, T.Y., Chong, S.P. and Gopal, K.

Introduction

Applied Agricultural Research Sdn. Bhd. (AAR) is one of the few companies still very much involved in propagating oil palms by tissue culture. Todate AAR has 4000 ha of its clones planted as commercial test plantings spread over forty estates in Peninsula Malaysia and Sabah as well as eighteen trials with a total area of 182 ha. Much valuable experience has been obtained from these plantings which has placed AAR in a stronger and more positive position on the prospects of commercial tissue culture of oil palm.

Lessons learnt

- Clonal behaviour in terms of somaclonal variation such as mantling and extended juvenility, poor pollination and yield cycles.
- Clonal performances in terms of FFB production and oil yields.
- Clonal x environmental interactions and their importance to clone evaluation and their consequent selection.

Clonal behaviour

Mantling

Mantling affected over 60% of AAR's clones and reclones todate. In terms of mantled ramets, ramets from clones that were cloned from 1983 to 1988 and from reclones that were put into culture from 1989 to 1991 generally had mantling levels exceeding 5 %. Subsequent clones and reclones that were cultured from 1992 onwards produced ramets with tolerable mantling levels of below 5% at around 2.6%. The reduced mantling incidences of the clones and reclones may be attributed to adoption of improved laboratory protocol, stringent culture screening and selection in the laboratory as well as at all stages of development of the ramets up to field planting. There is also the possible contributing factor of genetic differences among the wider range of ortets sampled.

Extended juvenility

Extended juvenility was found to occur in the field from about 18 months after field planting. The extended juvenility in ramets is manifested in the high frequency and prolonged production of parthenocarpic bunches particularly associated with erectish palms with shortened fronds. In normal seedling derived palms, parthenocarpic bunches may occur when there is inadequate pollination and are commonly noted in the first flowering cycles of young palms where there is a pronounced female flowering cycle and where no ablation is done. For ramets with extended juvenility, it was noted that the parthenocarpy would extend up to the third or fourth flowering cycles when the ramets are well into their 30th month of planting. In such severe cases of extended juvenility, because of the very high and precocious sex ratio, a very large proportion of the bunches abort. Recovery to fertile bunches occur but can be variable.

The problem of extended juvenility was found to occur in only a few clones and within affected clones. They were only restricted to a very few embryoid lines of the clone. The same embryoid line also produced normal looking ramets. Some signs of recovery were also noted in the erectish ramets, which we suspect could be a transient expression of the carry-over effects of in vitro treatments. Studies on this somaclonal variant are in progress.

Such erectish palm form is commonly perceived as a runt characteristic. However if these ramets are producing normal bunches and have very high sex ratios, the norm of equating of erectish palms with runts would not apply here. Perhaps studies could be made on ramets with erectish canopy architecture to test their crop photosynthetic efficiency. With their erectishness, more points can perhaps be planted per unit area for increased productivity.

Poor pollination

Poor pollination may arise in clones because of the high productivity of clones particularly in large monoclonal plantings. In a 35 ha 1992 commercial test planting in Kampar Estate on very sandy Holyrood series soil, the estate reported very high numbers of abortive bunches in 1997. A census of male inflorescences and bunches was done The census results showed that the clones had a very pronounced female flowering cycle where the overall male to female inflorescence ratio was 1:119 and ranging from 1:10 to 1:624, with three clones having no male inflorescences at all. The pronounced female cycle led to a high level of aborted and poorly pollinated bunches of 7.8% and consequent loss in yield (Table 1).

TABLE 1. ESTATE A, PM92A1/35HA AAR 'E' CLONES : EFFECTS OF ASSISTED POLLINATION ON FFB YIELD AND % ROTTEN BUNCHES

Year	Harvesting rounds	Bunch weight (Kg)	Yield (T/Ha)	% Rotten bunches	Remarks
1994	23	3.5	13.4	19.1	10 months' yield
1995	30	4.6	20.2	15.1	
1996	33	7.8	32.2	4.1	
1997	32	8.2	28.5	5.1	Assisted pollination commenced in Sept 97
1998	30.5	11.4	35.4	4.9	
1999	36	13.0	43.4	3.7	
2000	33	13.3	36.0	1.2	
2001	30	14.1	35.3	0.9	
2002	34	15.6	35.0	0.5	
2003	15	15.6	16.4	0.3	6 months' yield. Assisted pollination stopped from Jan.

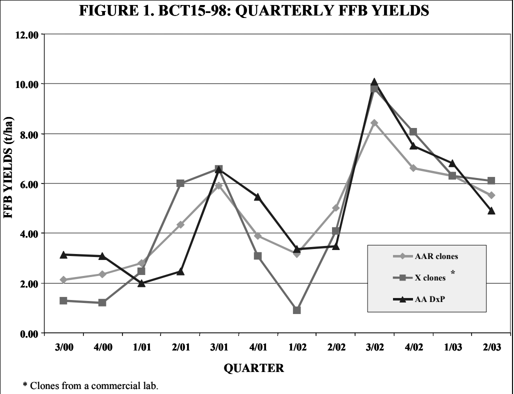
The estate commenced assisted pollination in this block in September 1997. The full effect of the assisted pollination was estimated to come in from February 1998. In 1998, the bunch weight increased by 39% to 11.4 kg while the number of rotten bunches declined and has been declining since (Table 1). A record yield of 43.4 t/ha was obtained in 1999 and yields have been averaging 35t/ha/yr. But because of the tallness of the palms, there were difficulties in carrying out the assisted pollination and this operation has ceased since 2003. However it was noted that although there were more male inflorescences present, the female cycle was still pronounced. Average bunch weight was still on the low side partly due to poorer fruit set since the cessation of assisted pollination.

Arising from this problem of poor pollination in clones, all large scale AAR clonal plantings after 1998 had a 20% DxP seedling material incorporated into them as an interim measure pending further observations and studies.

Yield cycles

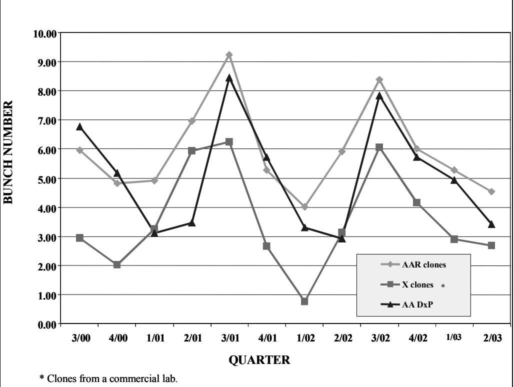
The availability of clones allowed us to study seasonal yield cycles of different genetic materials. To illustrate the yield cycles observed in clones, quarterly FFB yields from a clonal evaluation trial was plotted out (Figure 1). This trial included clones referred to as X clones from a commercial laboratory. It was noted that both the clones and the AA DxP seedling control followed a similar yielding trend that was apparently dictated by the growing environment with yield troughs that coincided with the low yielding cycles of the estate where the trial was located.

FIGURE 1. BCT15-98: QUARTERLY FFB YIELDS



Between the two sets of clones, there were also differences. Yields of X clones tended to be more cyclical with large amplitudes – particularly for the period of 1/02 to 3/02. In comparing the bunch numbers and bunch weights (Figures 2 and 3) the bunch numbers of X clones were about 60% lower than AAR clones while their bunch weights were 60% heavier. The amplitudes in bunch number for the three sets of materials (AAR clones, X clones, AA DxP) appeared to be similar but because of the X clones' fewer big bunch characteristic, the drop in yield during the dip period appeared to be more severe. During peak yielding periods, the big bunch based materials compensated for their low bunch numbers with even bigger bunches. This lends support to the general observation that materials with higher bunch numbers were more likely to weather variable growing conditions better than those with low bunch numbers.

FIGURE 2. BCT15-98: BUNCH NUMBERS



Clonal Performances

Since 1994 AAR clones produced have been classified under three categories: production clones, evaluation clones and reclones.

Production clones were cloned from ortets that met the following minimum criteria:

- High FFB yield - ≥ 95% of DxP Dumpy AVROS or ≥ 90% of DxP AVROS.
- High O/B - > 27%
- Short palm - ≤ 95% of DxP Dumpy AVROS or ≤ 80% of DxP AVROS.

besides other desirable secondary traits e.g. thinner petioles, lighter canopies, good fruit size, thick mesocarp etc. These clones are targeted for commercial test plantings as well as for field trials.

Evaluation clones are clones from ortets that failed to meet any one of the minimal criteria, usually for FFB. They were produced in limited numbers for trials and observation plots only.

Reclones were the recloning products of production clones or evaluation clones which had performed well in trials.

These clones were featured in trials planted since 1997 (Table 2). FFB yield levels were generally satisfactory, close to the estimated site yield potentials (SYP's). The advantage of clones over the DxP varied from 3% to 22% with an average of 14%. There were a number of clones that yielded more than 10% (average confidence level) of the DxP. The difference in mean FFB yields between the production and evaluation clones was minimal. The lower FFB yield for the reclone can be explained by the choice of the reclone (as control clone), which was not based on its better FFB but on oil yields. It must be pointed out that these results are still preliminary or early, and that use of commercial DxP for comparison can be biased by sampling error involved in sampling the DxP seeds of variable genetic constitution.

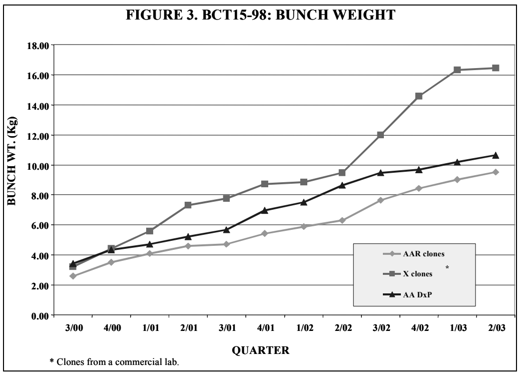
TABLE 2. SUMMARY OF AAR CLONAL TRIAL RESULTS: FFB YIELDS (T/HA/YR)

Trial	Year of yield data	Prod. clone yield	Eval. clone yield	Reclone yield	Range of clonal yield	Ave. clonal yield	AA DxP yield	Clones vs DxP (100%) %	Trial mean yield	SYP	No of clones >10%> DxP
BCT13-97	2000-03[1]	19.2	20.0	13.7	13.7-23.4	19.1	15.6	122	18.6	20.0	10/12
BCT14-97	2001-03	22.7	21.9	20.4	17.4-26.2	21.9	20.3	108	21.7	23.0	6/11
BCT15-98	2000-03	19.4	-	15.5	15.5-21.8	19.4	18.9	103	18.8	19.0	3/8
BCT16-98	2001-03	14.1	12.7	12.2	8.8-18.5	13.6	11.9	114	13.4	15.0	23/24
Mean		18.9	18.2	15.5		16.8	14.3	114			

[1] Up to June 2003

The O/B generally regarded as a more heritable component, is a very important criterion in our selection of ortets. Its selection appeared to be faithfully carried through to the clones as illustrated in Table 3. Although the AA DxP materials which served as control had a high O/B, the majority of the ortet clones still achieved more than 1.5% (average confidence level) units higher O/B than the DxP.

FIGURE 3. BCT15-98: BUNCH WEIGHT



From the FFB yields and O/B figures, the extrapolated oil

TABLE 3. SUMMARY OF AAR CLONAL TRIAL RESULTS: OB (%)

Trial	Year of yield data	Prod. clone O/B	Eval. clone O/B	Reclone O/B	Range of Clonal O/B	Ave. clonal O/B	AA DxP O/B	Trial mean O/B	No of clones>1.5% units >DxP
BCT13-97	2000-03[1]	29.8	28.5	30.7	26.6-31.0	30.3	27.7	29.1	6/12
BCT14-97	2001-03	29.8	29.0	30.7	27.6-32.0	29.6	27.4	29.6	8/11
BCT15-98	2000-03	30.3	-	32.5	29.3-32.5	30.6	26.7	28.5	8/8
BCT16-98	2001-03	30.7	29.9	31.3	27.1-33.8	30.5	29.6	30.4	9/24
Mean		30.2	29.1	31.3		30.3	27.9		

[1] Up to June 2003

TABLE 4. SUMMARY OF AAR CLONAL TRIAL RESULTS: OIL YIELD (T/HA/YR)

Trial	Year of yield data	Prod. clone yield	Eval. clone yield	Reclone yield	Range of clonal yield	Ave. clonal yield	AA DxP yield	Clones vs DxP (100%) %	Trial mean yield	No of clones >10% > DxP
BCT13-97	2000-03[1]	5.7	5.7	4.2	4.2-6.7	5.6	4.3	130	5.4	10/12
BCT14-97	2001-03	6.8	6.3	6.2	5.4-7.7	6.5	5.3	123	6.4	7/11
BCT15-98	2000-03	5.9	-	5.6	4.9-6.6	5.9	5.0	118	5.8	6/8
BCT16-98	2001-03	4.3	3.8	3.8	1.9-7.2	4.2	3.5	120	4.1	15/24
Mean		5.7	5.3	5.0		5.6	4.5	124		

[1] Up to June 2003

TABLE 5. BCT4-89 AND BCT10-91: EFFECTS OF CLONE X LOCATION ON FFB YIELDS.

Clone	BCT 4-89 FFB yields (t/ha/yr)		BCT 10-91 FFB yields (t/ha/yr)	
	1998-01	Rank	1998-01	Rank
1/3	30.7	5	27.1	5
2/7	29.9	6	27.1	4
3/12	34.2	2	30.8	1
6/22	32.4	3	26.3	6
7/26	31.6	4	30.0	2
9/28	37.6	1	27.5	3
10/39	26.5	8	24.6	8
11/283	26.5	9	21.9	9
12/84	29.3	7	25.5	7

Spearman rank correlation, r = 0.81 for BCT4-89 and BCT10-91 FFB ranking (p - level = 0.007)

TABLE 6. BCT4-89: AVERAGE FFB YIELDS OF CLONES FOR TWO DIFFERENT THREE-YEAR PERIODS

Clone no.	Average FFB yields					
	1994-96 (t/ha/yr)	Ranking of clones	1999-01 (t/ha/yr)	Ranking of clones	1994-01 (t/ha/yr)	Ranking of clones
1/3	26.2	4	32.9	3	29.8	5
2/7	26.0	5	31.9	6	28.4	6
3/12	30.6	1	37.5	1	33.6	1
5/15	22.5	11	30.6	7	25.2	11
5/17	23.3	9	30.5	8	26.8	9
5/14C	25.6	6	29.9	9	27.8	7
6/22	27.9	2	32.7	5	31.1	2
7/26	27.6	3	32.8	4	30.1	4
9/28	22.9	10	37.1	2	30.3	3
10/39	21.7	12	27.1	11	25.9	10
12/84	23.8	7	29.6	10	27.4	8
11/283	23.6	8	27.1	12	25.2	12

Spearman rank correlation, r = 0.55 for 1994-99 ranking and 1999-01 ranking (p – level = 0.06)

yields of the trials were computed (Table 4). Nearly 70% of the clones achieved more than 10% oil yield advantage over the AA DxP with some as high as 59%. As oil yield was computed from FFB yield, the caveats on the comparisons between clones and DxP for FFB would also apply.

Clone x environmental interactions

As clones are considered to be genetically homogeneous, clone x environment interaction effects would likely assume importance. Environmental effects may be spatial (location) or temporal (age).

Comparison of the relative rankings of the same clones planted in Trial BCT4-89 (Balau, Selangor) and BCT10-91 (Paloh, Johore) showed a change in ranks of some clones (Table 5) even though the growing conditions in both trials were not that different, lending support on the need for clone x location trials .

Trial BCT4-89 being recorded for a longer period allowed us to examine the importance of clone x age effects (Table 6). Two 3-year periods, 1994 to 1996 and 1999 to 2001 were used to compare the relative ranking of the clones for each period. Out of the 12 clones, 6 clones had differences in ranking of more than two positions between the two periods. The implications of this will be discussed further later,

Considerations for future clonal evaluation trials

Some of the implications from the lessons learnt to date from the clonal trials and commercial test plantings would need to be taken into consideration in the planning of future trials. These are:

- To reduce somaclonal variations, we should stick to well tried cloning protocol and disciplined quality control measures and put less reliance on a few clones only.
- As more palms are cloned

and ramets mass-produced, particularly with recloning and the liquid system, we must be vigilant for epigenetic manifestations such as extended juvenility.

- Poor pollination in large clonal plantings particularly in good areas would require further study including the pattern of mixed clone plantings and the quantum and pattern of the addition of DxP materials.
- The current limited studies on yield cycles in clones showed largely environmental influences. This may lead to selecting clones for planting in sites that would bring out their desirable characteristics.
- Our current clonal trial results lend further support to our contention and strong emphasis on selecting for high OB and less stringent selection for FFB in ortet selection.
- With the large influence of the environment and clone x environment interaction on clonal FFB yields, trials sited in different locations of the country would appear to be necessary.
- Finally, clone x agronomy effects e.g. clone x spacing, clone x fertilizer, clone x planting arrangement, would need to be studied in trials, in order to bring out the full potential of the clones. Crop improvement has been universally shown to be derived from equal contributions from genetic and agronomic improvement. The number of such trials needed appears daunting and it is left to the ingenuity of the agronomist/crop scientist to devise the minimal number of such trials needed within his resources to maximize useful information obtainable on his clones.

SPECIAL ADVISORY NOTE ON THE MANAGEMENT OF POTASSIUM DEFICIENCY IN MATURE OIL PALMS

By Curtis Tan

Introduction

Potassium is one of the four major nutrients required by oil palms. It plays an essential role in many physiological processes of plants, such as the activation of enzymes, synthesis of proteins, starch and fats, osmoregulation (e.g cell extension, stomata regulation) and enhancing the effects of phytohormones required for meristematic tissue growth (Goh and Hardter, 2003). Potassium affects bunch size, bunch number and is an important factor in disease resistance (Rankine and Fairhurst, 1999).

Potassium is the nutrient required in the largest quantity by oil palms. Teoh and Chew (1988) computed that mature oil palms immobilised 589 to 831 g K/palm/year. A large amount of K is removed from the field from fruit bunches which contain approximately 4.5 g K/kg. In established estates, 30% to 60% of the manuring expenditure on mature oil palm goes to the replacement of K removed from the field (Goh, *et al.*, 1993).

Reports compiled by Goh *et al*., (1993) showed that on coastal soils, response to K application ranged from 2.6 percent to 12.2 percent, with average response of 7.6 percent. On sedentary inland soils, response ranged from 2.3 percent to 52.3 percent with average response of 13.5 percent. On many soils, especially sandy and peat soils, lack of K is usually the largest or single nutrition factor affecting yield (Goh and Hardter, 2003).

Symptoms

Potassium deficiency symptoms are not immediately visible, but appear in the form of reduced growth rates, decreased leaf turgor and increased susceptibility to drought and diseases such as *Cercospora* leaf spot, *Ganoderma* basal stem-rot and vascular wilt (Goh and Hardter, 2003).

vertheless, a few visible symptoms have been associated with K deficiency in mature oil palms.

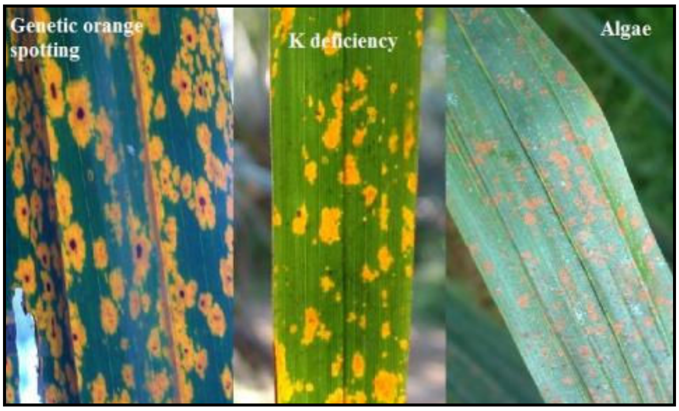
i) Confluent Orange Spotting

This is the most common symptom of potassium deficiency. It is also sometimes known as 'speckled yellows' or 'speckled bronzing'. Chlorotic, initially rectangular spots which change m pale green through yellow to deep orange, develop and enlarge on the frond pinnae and fuse to form lesions of a bright orange colour. This will first appear on older fronds, since K is remobilised to the younger fronds where cell activities are more robust. Necrosis within the spots is irregular but not uncommon, and may become the site of secondary fungal infection before the frond desiccates.

The presence of orange spots should not be mistaken for algal infestation of palm fronds, which usually occur on the upper frond surface exposed to dust. An easy way to differentiate between the two orange spotting phenomena is that lesions caused by K deficiency are transparent when held against sunlight while spots due to algal growth are opaque.

Some palms may exhibit orange spots due to genetic abnormality, but this usually occurs on individual palms whereas the surrounding palms remain healthy. The spots are visually indistinguishable from those of confluent orange spotting, but they remain a permanent feature of the affected palms.

K deficiency may also be mistakened for the 'orange fronds' symptoms of Mg deficiency, particularly when the former is at the severe stage when the spots have coalesced. However, the orange yellow in Mg deficient-palms are generally of a lighter hue than the deep orange spots of K-deficiency.



ii) Mid-crown yellowing/ diffuse yellowing

Oil palm with K deficiency may exhibit diffuse yellowing where the middle and lower fronds become yellow and later turn brown, a symptom more commonly found in peat soils and acid soils. A clearly defined and often necrotic band then develops around the margins of the pinnae (Goh and Hardter, 2003). This usually happens after prolonged periods of dry weather. In severe cases, old fronds will desiccate suddenly and die (Rankine and Fairhurst, 1999).

Mid-crown yellowing should not be mistaken for 'peat yellows' caused by Zinc deficiency on highly weathered acid soils and calcareous soils.

iii) White Stripe

The occurrence of white stripes especially noticeable in peat areas, where pale green 'stripes' form parallel to the midrib of the pinnae, is often associated with the imbalance between N, K and B. The width of the stripes will increase as the symptom worsens. Affected pinnae may become tapered from the base to the tip, while the fronds may develop an erect growth habit. It is widely believed to be caused by a lack of K and B, and an excess of N.

'White stripe' symptoms

Occurrence

Potassium deficiency is common in palms planted on peat soils, sandy soils and acid soils. It is also commonly found in high-yielding oil palm fields when insufficient K fertiliser has been applied. K concentration of less than 0.15 cmol/kg in the soil has been shown to cause deficiency symptoms to develop in mature oil palms (Rankine and Fairhurst, 1999).

Treatment

The application of K fertilisers such as Muriate of Potash, from 1.0 kg – 4.0 kg is required to remedy deficiency observed. The exact rate will depend on the severity of deficiency, soil type, growing conditions, palm sizes and climate. Higher application rates may be required on peat soils, sandy soils or soils with very low inherent K, with the applications split into several rounds.

Applications of K fertiliser annually are essential as large amounts of the nutrient are removed through uptake by palms, ground vegetation and soil processes such as erosion, run-off and leaching. Care should however be taken in formulating K application rates due to its antagonistic properties with other nutrients such as Mg and P.

K fertiliser can be applied throughout the year, even under dry conditions. However, application during wet periods should be avoided to minimise surface run-off and leaching.

To replace K losses, certain agro-management practices such as the application of empty fruit bunches (EFB) which contain 2.41 % K on dry basis (Gurmit *et al.*, 1999) or bunch ash is highly advocated. Cut fronds should also be properly stacked in the field to recycle nutrients as well as minimise run-off.

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CURRENT OUTLOOK FOR INVESTMENT IN RUBBER

By Chan Weng Hoong

Since the publication of the article `Why rubber price may double` in May 2003 by Hugh Peyman in the ISP Planter magazine, price of rubber (RSS1) has risen from 387 sen per kg to 500 sen per kg in March 2004. Price of SMRCV has risen even higher to 580 sen per kg. The 2004 prices are a far cry from the low prices in the last 4 years (Table 1).

Why has the price of rubber gone up so sharply ?

Table 1 Price of RSS1 sen per kg (May 2000 – May 2003)

Year	2000	2001	2002	2003
Price	273	230	273	387

The underlying reason is the projected widening of gap between demand and supply of rubber in the next few years.

Demand

Nearly 80 percent of the demand for natural rubber is related to vehicles. Most goes to tyres, 35 percent of rubber in a car tyre is natural rubber while in trucks, some 85 percent. Overall natural rubber has a steady 46 percent share of the rubber tyre market. Substitution by synthetic rubber is not the threat it once was. After the Ford/Bridgestone debacle, tyre manufacturers are extremely reluctant to endanger performance and safety by substitution between raw materials to save on cost.

Demand appears set to continue to grow at its long term average rate of between 2.5-3.0 percent. With the growing economy of China wherein passenger car demand is predicted to grow 10 fold to more than 20 million cars per year by 2020 (Starbiz 24 January 2004), 3.0 percent appears the more likely demand rate.

Passenger car demand in China to grow 10-fold (extract from Starbiz dated 24/1/2004)

Supply

Planters in the last three decades have been pulling out rubber and putting in oil palm. Effectively very few are planting new rubber or replanting with rubber in the three main producing countries of Thailand, Indonesia and Malaysia that between them supply 70 percent of the world`s natural rubber. The next three producers Vietnam, India and China cannot make up for the shortfall. Peyman gives a realistic outlook on the likely shortfall in supply from 2001-2010 (Table 2).

At a demand growth of 2.5 percent per year, the shortage in supply would see a deficit rising annually and reaching 19.2 percent by 2010. Should annual demand grow by 3.0 percent, the deficit would reach 21.9 percent.

Unlike oil palm which can respond rapidly to any supply shortfall, rubber would take at least 5-6 years to reach maturity and a few more years to reach peak maturity. Peyman suggests that effectively it would take 10-15 years of consistent replanting and new planting to enable supply to catch up with demand.

With no significant increase in supply in the near term, rubber price is set to be on the upward trend for the next 10 years.

New Investment in rubber

Despite the bright outlook for rubber for the next decade, the three main producing countries of Malaysia, Thailand and Indonesia continue to switch to oil palm. Oil palm continues to give good to better returns compared with rubber in most situations in these countries. Individually, these countries also face problems peculiar to their own situation. In Malaysia, labour availability has always been a problem since the 1980s. In the case of Indonesia, Peyman mentions the absence of cess levy to fund new planting. Thailand has already exhausted land in the south and hence little to no new land is available for planting. Vietnam and Kampuchea are probably the new frontiers for rubber expansion provided political stability is in place.

Investment in rubber has also to include the economic value of rubberwood. Johari Hassan and Ramli Othman (2003), estimate a shortfall in supply of rubberwood to meet the burgeoning rubberwood furniture industry (valued at RM 4.9 billion in 2002), which may only be met by annual replanting of around 25,000 ha of rubber forest from 2003 onwards for the next 15 years.

In the light of the anticipated shortage of both latex and rubberwood in the near term, investment into rubber in appropriate locations appears bright indeed.

Rubber planters (and rubber agronomists), please stand up and be counted!

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Table 2 A Realistic supply outlook (after Peyman, 2003).

Scenario 2	**Rubber deficit 2001-10 (mn tons)**									
@2.5% demand growth	***01***	***02***	***03***	***04***	***05***	***06***	***07***	***08***	***09***	***10***
Demand	6.89	7.06	7.25	7.43	7.62	7.81	8.00	8.20	8.41	8.62
Supply	6.96	7.01	7.06	7.09	7.10	7.09	7.07	7.03	7.00	6.96
Deficit	(0.07)	0.05	0.19	0.34	0.52	0.71	0.94	1.17	1.41	1.65
% of demand	(1.0)	0.6	2.6	4.6	6.8	9.1	11.7	14.3	16.7	19.2
@3.0%	***01***	***02***	***03***	***04***	***05***	***06***	***07***	***08***	***09***	***10***
Demand	6.89	7.06	7.25	7.47	7.69	7.92	8.16	8.40	8.66	8.92
Supply	6.96	7.01	7.06	7.09	7.10	7.09	7.07	7.03	7.00	6.96
Deficit	(0.07)	0.05	0.19	0.38	0.59	0.83	1.09	1.37	1.66	1.95
% of demand	(1.0)	0.6	2.6	5.1	7.7	10.5	13.4	16.4	19.1	21.9

SOCIAL AND PERSONAL

The AAR Sports Club AGM was held on 24/1/03 and the following new committee members were elected for year 2003.

President	:	Tey Seng Heng
Vice President	:	Arif Sugandi
Secretary	:	Fazillah
Treasurer	:	Siti Norasikin
Section Representatives	:	Main Office (Norani Md. Said), Chemistry (Kamal), TC (Hatina), Balau (V. Subramaniam), Paloh (Zainuddin).

On 06/07/03, a friendly football game between AARSC and the Indonesian Students of UPM was held at UPM.

Sixty members of our club enjoyed a subsidized 3-day trip to Sarawak on 9th to 11th. The participants stayed at the Habour View Hotel and enjoyed visiting several interesting places like the famous Waterfront, Kuching City, Cultural Show Centre, Pasar Seni Satok, a pots making factory and a bird-nest processing house. For those who could not make it to Sarawak, a separate trip to Penang Island was organized on 30/8/03 for 120 persons.

A Mini Sport was successfully organized on 11/10/03 in the Main Office Complex and a similar activity also held in our Sub-station in Paloh Estate on 5/08/03.

Finally on the 6th of December 2003, an annual dinner was held at the "Kelab Tasik Putra", Putrajaya. It was an exciting and memorable night with good food, in-

Club members (Sarawak trip)

The famous Kuching waterfront

A few unique houses of different ethnic groups (Cultural Village)

In-house "Dikir Barat" performers.

Ping-pong game between officers and staff.

AAR's football players?

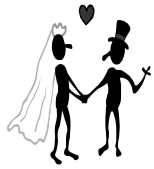
WELCOME & CONGRATULATIONS !

Name	Designation	Section	Date employed
En.Abdul Rahman bin Pasarai	Prob. Res. Tech.	Sabah Sub-station	1/12/03

Promotions 2004	Designation	Section	Date promoted
Mr. Teo Chor Boo	SRO	Main Office	1/1/04
Madam See Choon Mooi	ARO 2	Main Office	1/1/04
Puan Junainah bte. Ismail	Res. Clerk II	Database	1/1/04
Miss Susan a/p Samuel	Res. Clerk III	Statistics	1/1/04
Puan Aminah bte.Othman	Res. Clerk II	Advisory	1/1/04
Puan Mahizan bte. Mohamad	Lab. Asst. I	T. Culture	1/1/04
Miss Sivasakti d/o Subramaniam	Res. Clerk III	Main Office	1/1/04
Miss A. S. Sante	Lab. Asst. II	Balau	1/1/04
Miss Rajalachime P.	Res. Asst. III	Paloh	1/1/04
En. Rosli bin Hamazah	Res. Asst. II	Paloh	1/1/04
En. Azman bin Talip	Res. Asst. III	Paloh	1/1/04
En. Ahmad bin Ranjie	Res. Asst. II	Kampar	1/1/04
En. Ibrahim bin Abdullah	Res. Tech. IV.	Sabah Sub-station	1/1/04
Miss Saradey a/p Kunjukanoo	Res. Tech. IV	SP	1/1/04
Puan Nor Afrida bte. Mawardi	Res. Clerk IV	Paloh	1/1/04
Mr. Shanmuga Segar P.	Res. Tech. IV	Balau	1/1/04
Miss Victoria d/o Arulappan	Res. Tech. IV	GPS	1/1/04
Miss Glorey d/o Thomas	Res. Clerk IV	SP	1/1/04
En. Ahmad Risauddin bin Mamat	Res. Tech. IV	Batu Lintang	1/1/04

Name	Name of baby	Date of birth
Puan Umi Kalsum bte. Sabran	Nur Syafiqah (baby girl)	19/10/03
En. Ahmad bin Ranjie	Mohammad Shahfirul Isham (baby boy)	21/10/03
Puan Sharmie bte. Minka	Nur Syahriza (baby girl)	18/12/03
En. Saruddin bin Selamat	Muhammad Haziq Din (baby boy)	22/12/03
En. Mahadi bin Pordi	Muhammad Nurhakim (baby boy)	13/01/04
En.Arif Sugandi	Ariski Myardi (baby boy)	20/02/04
En. Isnain bin Norhassan	Nurain (baby girl)	05/03/04

Cik Zurinawati bte Awang Saad and **En. Tumiran bin Amaludin** who tied the knot on 28/12/03.



THE PERFECT CHICK

A MAN WALKS INTO A CAFÉ FOLLOWED BY AN OSTRICH. `GIVE ME COFFEE AND DOUGHNUT`.
`WHAT ABOUT YOU ?` THE WAITER ASKED THE OSTRICH.
`SAME FOR ME` REPLIED THE OSTRICH.
`THAT`LL BE $16` AND THE MAN DUG INTO HIS POCKET AND PRODUCED $16.
THE NEXT DAY THE MAN CAME AGAIN AND ORDERED A COKE AND FRIED RICE.
`ME TOO` SAID THE OSTRICH. AND WHEN THE WAITER ASKED FOR $20, THE MAN PRODUCED THE EXACT AMOUNT.
THIS WENT ON FOR A WEEK AND THE WAITER WAS AMAZED AT THE EXACTNESS OF EVENT.
THE WAITER ASKED THE MAN,`HOW IS IT YOU ALWAYS PRODUCE THE EXACT AMOUNT OF CHANGE EVERY TIME YOU PAY?`

`OH` THE MAN REPLIED, ` I SAVED A GENIE FROM DROWNING AND HE GAVE ME TWO WISHES. FOR THE FIRST WISH I ASKED THAT I WOULD ALWAYS HAVE ENOUGH MONEY IN MY POCKET TO PAY FOR ANYTHING I WANTED`.
`THAT WAS SMART` THE WAITER REPLIED, ` AND THE OSTRICH?`
THE MAN SIGHED,` FOR THE