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EDITORIAL

The August-September months have been a particularly busy season in terms of attending conferences and presenting papers for many ISOPB members. In August 19-21, PORIM organised a workshop on "Malaysian Palm Oil Industry For The Year 2000", where leaders of the Malaysian palm oil industry pitted their brains to come out with a strategy for palm oil for the future. Two papers on breeding, the first by Professor Yap Thoo Chai (University of Agriculture, Malaysia) and Tan Yap Pau (United Plantations) and the second by Chan Kook Weng and Dr. Aminuddin Rouse (Guthrie) are reproduced in this Newsletter.

In August, Dr. Rajanaidu and Professor Yap attended an International Symposium on Population Genetics and Germplasm Resources in Crop Improvement at University of California, Davis in which R.W. Allard was honoured for his contributions to population and quantitative genetics and plant breeding. Dr. Rajanaidu went on to attend the World Genetic Congress at Toronto where he met J. Meunier (IRHO). Dr. Rajanaidu presented a poster paper "Genetic resources sampling strategy based on variance components estimated" at the conference.

Reminiscent of an earlier meeting in 1983 a bunch of ISOPB members descended on the 6th International Eucarpia Congress and its satellite symposium on tissue-culture (2nd Nordic Symposium on Cell & Tissue Culture. The Biotechnology of Crop Plants) in Helsingor, Denmark from September 9-16. The theme of the Congress was : "Genetic Manipulation in Plant Breeding. Biotechnology for the Plant Breeder". The ISOPB members comprised the following : Tan, Yap-Pau and Ms. Ho, Yuk-Wah of United Plantations, Dr. Lee, Chong- Hee of Harrisons Malaysian Plantations, Tan, Swee-Tian of Sime Darby, Christopher Donough of Pamol and Dr. Hj. Halim Hassan and Cheah, Suan-Choo of PORIM. Apparently Baudouin (IRHO) also attended another satellite symposium organised by Eucarpia on the same theme at Uppsala, Sweden.

Dr. Soh (Applied Agricultural Research) met Ms. C. Pannetier and P. Engelmann of IRHO at Versailles, France during the Moet. Hennessy Colloquium on Advanced Technology and Breeding Strategy, September 19-21. Dr. Soh presented a poster paper on "Clonal Propagation of Oil Palm : Current Experiences and Their Implications to Breeding and Cloning."

Write-ups on the highlights on the Davis symposium, the International Genetic Congress, the Eucarpia Congress, and Dr.Soh's poster paper for the Moet. Hennessy Colloquium, will appear in the next issue of the Newsletter as this current issue is already full.

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Feature Articles:

A. THRUST OF FUTURE EFFORTS IN BREEDING AND GENETIC ENGINEERING

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ABSTRACT

A review is made on the impact of biotechnology in assisting plant breeding to increase oil palm yield. The recent advances in biotechnology offer new scope for breeding and selection. The relevance of biotechnological techniques such as tissue culture, somaclonal variation, protoplast fusion and genetic engineering to oil palm is examined and compared with those done on the major oilseed competitors such as soybean, cotton seed, sunflower and rapeseed. In oil palm, clonal propagation is progressing towards commercialisation. Somaclonal variation has regenerated variants with higher oleic acid thereby demonstrating the ability to reduce the long breeding cycles from 30 years for producing a new variety to about six to seven years. The progress with protoplast fusion is slow. Genetic engineering is still at its infancy and is confined to molecular finger printing techniques of restricted fragment length polymorphisms (RLFP) and isozyme analysis. The paper calls for a multidisciplinary approach in solving the problems encountered in the adoption of biotechnology in oil palm breeding.

INTRODUCTION

The success of any crop improvement programme depends on the extent of genetic variability in the base population. The strategies mapped out by the conventional breeding techniques in oil palm are invariably characterised by two basic requirements. One is the long breeding cycles in multiples of about eight years per generation to produce a new variety and the other is the lower selection intensity achieved when many traits are considered resulting in slower genetic recombination of the desirable traits of high oil yield ha^{-1}, high oil unsaturation, low height increment, yield stability in different environments and tolerance to certain diseases. It is estimated (Noiret *et al*, 1985) that over the last 30 years, the oil yield under normal estate conditions has increased from 3.3 to 4.5 t ha^{-1} yr^{-1}. Under optimum condition, the average oil production is raised to 6.3 t ha^{-1} (44.3 kg $palm^{-1}$ yr^{-1}) with a range from 3 to 11 t ha^{-1} (21 to 77 kg $palm^{-1}$ yr^{-1}). The improvements in other parameters are 10% increase in the unsaturated fatty acid and 20% average height reduction over the same period. Before the advent of tissue culture, it has not been possible to multiply rapidly elite palms with higher yields to create clones since oil palm does not lend itself to conventional methods of vegetative propagation.

With the report on tissue culture by Jones (1974) much enthusiasm was created in the oil palm industry. This led several Malaysian plantation groups over the past decade to venture into clonal propagation of oil palm through tissue culture with multinational companies. For example, HMPB with Unilever formed Bakasawit locally and Unifield overseas, Sime Darby and IPRI (U.S.) ventured into AgriBio Corporation, PORIM with Wye (U.K.), Felda with IRHO (France), United Plantations with PORIM and HRU with Chemara. Since then some have folded up. In Singapore, Plantek was established with equity participation of Native Plants Inc. (U.S.), TATA group (India), Sumitomo (Japan) and Intraco (Singapore).

The prospects of clonal multiplication received a dramatic set-back in 1985 due to the discovery of major abnormalities (Corley *et al* 1986) such as mantled and parthenocarpic fruits, androgyny, erect shortened fronds and leaflets in the clonal palms produced from a range of laboratories in Malaysia, Indonesia, U.K. and France. No definite explanation of the causes was forwarded for these

1. Paper presented at the Workshop organised by PORIM on 'Malaysian Palm Oil Industry for the year 2000' held on 19th to 21st August 1988 at Merlin Hotel, Fraser's Hill.

observations. Further no conclusive evidence of higher oil yield in clonal palms is reported at present. The basic question often asked is whether the oil palm industry is discouraged by this initial set-back caused by the abnormality? With more advances in tissue culture of oil palm (Jones, 1983) and reports of technologies in other crops (Sharp, 1986) on clonal propagation, somaclonal variation, protoplast fusion and genetic engineering for the genetic manipulation to improve traits, the answer is for us to move ahead. The survival of the industry is dependent on the renewed vigour of its R&D efforts on plant breeding, tissue culture and related biotechnology.

This paper examines the current state of the art, explores the practical relationship between oil palm breeding and biotechnology and compares similar work in other major oilseed competitors such as soybean, rapeseed, cotton and sunflower.

PLANT BREEDING AND CLONAL PROPAGATION

In conventional oil palm breeding, the breeding cycles are long and there is wide variability in the resultant progenies. With tissue culture, the aim is to multiply in large number those individual palms with desirable traits without going further through another sexual cycle. Thus, heterosis can be fixed and more traits be selected in a single generation when compared with conventional breeding which may take many cycles of selection.

In tissue culture, the somatic tissues are grown in simple growth medium in flasks or test tubes. The callus cells grow into embryoids and develop into small plantlets in response to certain growth hormones. The plantlets transferred to soil are hardened and transplanted into big polybags before field planting and evaluation. In the culturing of these explant tissues, the growing cells are unstable especially when proliferating rapidly during the callus phase. Thus, it is not surprising that many of the plants regenerated from these cell cultures may be genetically altered. However, the current abnormality observed is believed to be epigenetic (non-genetic in nature) where the variation is phenotypic and is affected by genotype differences within species, source of explants, culture conditions and composition of culture media. Presently, the PORIM's Coordinated Group on Abnormality is looking into the exact causes of the problem. As each step in the present method with solid media culture is a time-consuming manual asceptic transfer, the scale up of operation will encounter substantial losses due to poor hygiene. A different approach using culture in liquid media is tried in Guthrie. This involves the cultures of single cells or group of cells which are synchronised to develop into embryoids. Upon maturation the embryoids are dispensed into solid media for further development as those used for the solid culture method.

The direct applications of clonal propagation technology in oil palm are seen in four promising areas. The first is production of tenera ramets. The second is the cloning of superior palms as biclonal parents to produce biclonal seeds. The third application is for maintaining genetic variability by cryogenic storage of cultures in liquid nitrogen at very low temperature (Engelman *et al*, 1987). The fourth application is for embryo culture and such embryo rescue technique has been successfully used in Chemara in the propagation of pisifera embryos after their selfing or crossing where normally the bunch rot sets in before full embryo development.

Among the oilseed competitors, clonal propagation of soybean, cotton seed, sunflower and rapeseed has been achieved but because of the short generation time and rapid turnover in these annuals, seed propagation rather than clonal propagation would be more desirable.

PLANT BREEDING AND SOMACLONAL VARIATION

In conventional plant breeding, we exploit the genetic variation that occurs naturally. Enhancement in the genetic variability among plants regenerated from somatic cell cultures is termed somaclonal variation. Such variation can be undesirable as seen in the abnormal palms or desirable as can be seen in the increase in high oleic acid content in one of the oil palm variants reported by Jones (1984). The above is based on variations observed in somatic cells derived from leaf, stem or root cells. However, there are also variations observed in the cultured cells of pollen and egg cells and these are termed gametoclonal variations. Such variations are useful as reported in rice where a disease resistant variant has been regenerated. Thus not all changes from somaclonal and gametoclonal variations are undesirable and they can be used to develop new breeding lines for use in development of improve varieties. Thus, somaclonal variation may be a possible solution for overcoming the narrowing genetic variability in the present oil palm breeding populations.

Another important feature, related gamete cells but not related to somaclonal variation, is the recovery of cultures from pollen or pollen still contained in anthers. Another culture can be used to achieve hybrid sorting. Here, the anthers of hybrid lines are cultured to recover haploid plants that may express the best characteristics of each parent plants. This method is used extensively in rice and rubber to produce new crop varieties. The diploidisation of these haploid lines will achieve homozygosity in a single generation and heterosis can be exploited fully in the development of hybrid varieties from inbred lines. With anther culture, the pertinent question asked is whether heterosis is solely responsible for hybrid vigour in oil palm?

Among the oilseed competitors, sunflower and rapeseed are presently more amenable to somaclonal and gametoclonal variations than soybean. Comparatively, the principal benefit from somaclonal and gametoclonal variations lies in the shortening of time by half from seven to eight years to three to four years for development of a new variety in annual crops such as rapeseed, sunflower, soybean and cotton and by three quarter the time from 30 to 40 years to about seven to eight years in perennial crop like the oil palm (Jones, 1984).

PLANT BREEDING AND PROTOPLAST FUSION

In conventional breeding, crossing between distantly related species is often difficult and unsuccessful. Protoplast fusion is a new technology that permits the development of hybrid plants which is impossible to achieve via conventional sexual hybridisation. In protoplast fusion technology, the best genes of plant A are combined with the best of plant B by fusing the cells of two plants together in a test tube using a certain chemical fusion agent after their cell walls are enzymatically digested away. The resulting new hybrids, when integrated into the existing breeding programme will permit development of new varieties that are otherwise not possible by conventional means. The primary limitation is the difficulty to regenerate plants from protoplast.

However recently Dr. Ruslan Abdullah who is now working at Chemara was successful in regenerating the full rice plant from an unfused protoplast cell. This is very encouraging as rice is a monocot where hitherto such regeneration is confined only to dicots. Indeed the fusion of two protoplast cells followed by regeneration to full rice plants had since been achieved. This opens two possibilities in the perennial monocot like the oil palm, one is the fusion of the two protoplast cells and secondly, the regeneration of plants from the fused protoplast cells are likely to be successful.

A practical application of protoplast fusion is the development of hybrids where the cytoplasm, of a cell, in conferring certain desirable traits can be combined with the cytoplasm of another with accompanying transfer of organelles between them. In maize, this is used to transfer male sterility for production of hybrid seeds.

Among the oilseed competitors, only rapeseed and cotton seed have been successfully regenerated from protoplast fusion and it precludes soybean and sunflower. As regeneration from protoplast is not yet achieved with oil palm insertion techniques such as electroporation and microinjection to improve selection will not be discussed here. Thus, the prospect is slim of an immediate use of protoplast fusion to speed up the interspecific hybridization programme with the South American oil palm to overcome its sterility problem. We will, for the time being, continue to rely on conventional breeding by taking several generations to create fertile crosses of high agronomical value.

PLANT BREEDING AND GENETIC ENGINEERING

In conventional breeding, multiple gene transfer occurs. With advances in genetic engineering, a single gene transfer of a particular trait is now possible. Genetic engineering technology encompasses a group of genetic modification tools. It includes gene mapping, gene splicing and DNA recombination. For these to be done, the work requires the isolation and characterisation:

i) at sub-cellular level of the membrane bound organelles like mitochondria and chloroplast which contains 5% of the total genetic information where genes for photosynthetic efficiency, male sterility, herbicide resistance and certain disease resistance have been identified; and
ii) at molecular level of the nucleus which contains the remaining 95% of the genetic information

At the present stage, both the system involving in the detection and transcription of RNA is gene transfer and the method for analysing biologically the mitochondrial, chloroplast and nuclear genome should be pursued.

Currently, two areas are being explored in the oil palm at the molecular level. They are the finger-printing method of restricted fragment length polymorphisms (RFLP) (Cheah, 1987) and isozyme analysis of the changes in the DNA constituent and sequencing (Ghesquiere, 1984).

In RFLP work, restriction endonuclease enzymes which cut the DNA at specific sites will generate fragments which can be separated according to the size of gel electrophoresis. RFLP is the latest addition of genetic markers to be used in plant breeding programmes on two aspects. Firstly, it determines the genetic relationship in varietal identification, thereby offering protection of breeders' right and provides detailed genotypic information on parentage determination. Secondly, it identifies and maps out loci affecting quantitative traits. The ability to relate genotypic information to phenotypic traits will allow better and early selection with greater reliability of the multigenic traits where evaluation is often affected by environmental influences.

In isozyme analysis, any change in the DNA constitutent and sequencing, which is unique for every plant type, can be detected by electrophoresis. The enzymes or multiple forms of the same enzyme under electrophoresis will migrate differently. Such differences in migration are directly linked to the amino-acid constitution of the enzymes which is attributable to the modification in the nucleotide sequencing of the gene coding of these enzymes. From this, it is possible to know the exact genotype, the individual sample is taken from.

So far in RNA extraction, the preliminary work (Cheah *et al*, 1987) is confined to obtain RNA in quantities large enough for isolation of messenger RNA. Essentially, the work here must be related to the development of an effective gene transfer system which must be easily reproducible in order to develop widespread transfer of genes among the cultivated crops. In both oil palm and the oilseed competitors, the stage of the game is still at its infancy.

DISCUSSION

There is a need for the plant breeder to understand the same language as the biotechnologist especially with the many terminologies like gene mapping, finger printing, gene walking, jumping genes, cybrids, cryopreservation, somaclonal variation etc. which are used in the 'new genetics'. There is also a dire need for breeders to work closely not only with the molecular biologists but with the tissue culturists, agronomists, physiologists, plant pathologist and enzymologists on a multidisciplinary basis. From the description of the various technologies, the oil palm industry must adopt a two prong approach. Firstly, it has to bring together the expertise from the industry, the public institutions and the universities to pursue the testing of the plants derived from somaclonal variation, the regeneration of plants from protoplast fusion and research into genetic engineering particularly in gene mapping. Perhaps the setting up of the National Biotechnology Group is timely. Secondly the industry must keep abreast with the progress in the biotechnology work especially genetic engineering among the oilseed competitors. The field is moving rapidly and certain technologies in the oil seeds are moving downstream. Perhaps, PORIM together with the oil palm industry can help to form a group to spearhead the monitoring of their progress.

There is little doubt that in vitro technique can contribute to the success of plant breeding. Biotechnology particularly genetic engineering for crop improvement should not be approached in isolation. It is recommended that biotechnological effort be incorporated into the main breeding programme.

Finally, we have to pose the question of whether we have come to the end of the road for conventional oil palm breeding. Have we been exhaustive enough to select from the wide variations found naturally in the oil palm grooves in Africa and South America? I believe we have not and the marriage of the two will pave the way for obtaining better palms which will put us in good stead in the year 2000.

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BREEDING STRATEGIES OF OIL PALM TO FACE THE CHALLENGE IN THE YEAR 2,000

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INTRODUCTION

In Malaysia, the total area of oil palm in production is about 1.4 million hectares and the production of palm oil is approximately 4.1 million tons and about 85% of the product is for export (Pantzaris, 1987). It is expected that the amount of palm oil production will reach 7.5 million tons in the year 2,000. In 1985, the total palm oil production in the world was 6.8 million tons and Malaysia contributed 4.1 million tons which is 60% of the total.

In recent years, besides Malaysia, many other countries have also expanded their oil palm cultivation and therefore the marketing of oil palm is likely to face some problems in the near future. In addition, other countries that produce soybean, groundnut, sunflower, rapeseed and other types of vegetable oils also try to gain a greater share of the cooking oil market. In fact due to the low cost of production of palm oil compared to other annual oil crops, it has created a great threat to the soybean oil market. The recent campaign of the American Soybean Association to ask the American government to list palm oil as a saturated oil is an attempt to create fear among people by saying that consumption of palm oil will cause health hazard. This is the trump card for smearing palm oil by saying that it is a saturated oil even though results of the chemical analysis show that palm oil consists of 46% saturated (mainly palmitic), 43% mounsaturated (oleic) and 11% polyunsaturated (linoleic) fatty acids (Chong, 1987). Nevertheless, some experiments have shown that palm oil, unlike many other dietary fats, is cholesterol free and in fact the composition of various fatty acids is good for the health (de Witt, 1988).

Based on the present trend of development of the oil palm industry, improvement of oil palm should be carried out depending on usage. Perhaps it is timely to divide the quality of palm oil for cooking and industrial purposes. Further improvement of the crop should then be carried out according to these uses.

In this workshop, based on the development of oil palm breeding in the past, some breeding strategies are proposed to overcome some of the palm oil problems that are facing the oil palm industry.

DEVELOPMENT OF OIL PALM BREEDING IN MALAYSIA

Our present oil palm is of the Tenera genotype which is the F1 generation of the cross of Dura and Pisifera. However, the early breeding of the oil palm was based on four palms derived from Bogor Botanic Garden in Indonesia. These palms were known as Deli *Duras*. Mass selection was practised from the progenies of this Deli Dura population. This Deli Dura is characterised by a high bunch weight and very good and uniform bunch and fruit characteristics. The average yield of this genotype is 25-30 tons of fresh fruit bunches/ha. Due to the narrow genetic base of the Dura material, further improvement of this planting material is questionable.

In 1941, it was discovered that the inheritance of shell thickness was due to one pair of genes. The thick-shelled Dura (D) is homozygous for the dominant gene whereas shelless Pisifera (P) is homozygous for the recessive gene and the Tenera (T) which is intemediate in shell thickness is heterozygous for

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the gene pair. After the discovery of the inheritance of shell thickness, many companies in Malaysia introduced the Pisifera pollen and the DxP progenies from Congo, the Ivory Coast and Nigeria to produce local Tenera. During the early days, the emphasis in the production of these hybrids was in exploiting general rather than specific combining ability (Corley, *et al*, 1976). The production of Tenera has great impact in the oil palm industry in the country because Tenera was able to give 20-25% more oil compared to the Dura population. Consequently, cultivation of oil palm in Malaysia was switched from Dura to Tenera genotypes. The major bunch characteristics of Dura and Tenera are shown in *Table 1*.

During the 1950's, many Tenera materials were introduced into Malaysia to generate Pisifera parents for seed production. During this period, the Pisifera parents were evaluated against the selected Dura parents for general combining ability in producing good Tenera planting materials. This approach has been used for more than two decades. Since Tenera is the F1 hybrid of DxP but Dura was derived from four parents from Indonesia and the Pisifera were generally derived from selfing of Tenera, it can be seen that a high degree of inbreeding has taken place in the parental populations. Consequently, the genetic variability of the parental materials has been exhausted. Further genetic improvement of the crop based on the present parental materials might be difficult. Perhaps, it is timely to introduce more Dura genotypes from other sources to widen the genetic variability for further improvement of the crop. In addition, exploitation of specific combining ability should also be carried out even though the testing is more tedious.

Table 1. The bunch characteristics of Dura and Tenera (Ooi, 1978)

Character	Dura	Tenera
Fruit to bunch (%)	60	60
Mesocrap to fruit (%)	60 - 65	76 - 85
Shell to fruit (%)	25 - 30	8 - 15
Oil to mesocrap (%)	50	50
Oil to bunch (%)	18 - 19.5	22.5 - 25.5

BREEDING STRATEGIES

Based on the development of the oil palm breeding programme in Malaysia, it is noticed that further genetic improvement of the crop using the current approach to remove the yield plateau will be difficult. Hence some new strategies are suggested to face the challenges expected in the near future.

Exploitation of SCA

In the past 25 years, as there was a shift from Dura to Tenera, the seed production of Tenera was not able to cope with the demand. Hence the parents used for producing Tenera was based on the GCA rather than SCA. This approach is understandable as to exploit the SCA required more crosses and is time-consuming. In addition, even if the good SCA was found, the parental plants available would be very limited for seed production. From the breeding point of view, the main aim for developing hybrid varieties is to exploit heterosis and heterosis is due to good SCA effects of the two parents. Since in the past, the aim to develop F1 hybrids is to accumulate favourable additive genes in the hybrid the exploition of SCA has not been done. It is time that our breeding strategy should look for good SCA of the parents for hybrid seed production.

If parents with good SCA have been established, the parental materials can be then multiplied by means of tissue culture. The clonal parents which have proved to be genetically identical to the original parents are then used for producing hybrids for commercial production.

Cloning of superior F1 hybrids by means of tissue culture and release for commercial production directly is not recommended because many studies have shown that a high frequency of not "true to type" and abnormal plants will occur by means of the tissue culture technique (Yap, *et al*, 1985, Short, 1987). Such somaclonal variation is of widespread occurrence among crops including oil palm (Corley, 1986), sugarcane (Larkin and Scowcroft, 1983), rice (Sun *et al*, 1983) bananas (Muller & Sandoval, 1987), and many others. The mechanisms for the somaclonal variation are unclear for the time being. Consequently, screening of clonal materials is required before they can be released to the planter. In our present proposal, the clonal parents will be carefully examined before they are used for seed production. After going through this evaluation, the resulting F1 hybrids derived from the clonal parents will be able to retain their good SCA effects.

In this breeding programme, the present parents used for producing hybrid seeds may be crossed to the Nigerian materials introduced by Rajanaidu in 1973 for testing the SCA effects of a series of crosses because the genetic diversity of the existing oil palm breeding materials is very small.

Improvement of oil quality

The present palm oil consists of approximately 50% polysaturated fatty acids. With this types of oil, it is very difficult to penetrate the liquid oil market in temperate countries as it coagulates under low temperature. The American Soybean Association has been using this oil characteristic to smear the image of palm oil.

According to Rajanaidu *et al* (1985) there is not much variation in the *E. quineensis* (G) materials with respect to the fatty acid content. In consequence, further genetic improvement using the present existing materials may not achieve much progress.

E. oleifera (O) another species of oil palm has a high proportion of polyunsaturated fatty acid content in the oil. The level of fatty acid composition is very similar to that of olive oil, but oil yield of this species is relatively very much lower than the present DxP material and therefore it is not economical for commercial production. However, this related species of oil palm may be a good material for improving the quality of palm oil of G as pointed by many researchers (Hardon, 1969; Meunier, 1975). The oil composition of G and O and their F1 crosses are presented in Table 2.

From the above table, it is noticed that the fatty acid composition of the hybrid between the two species is about the average of the oil composition of the two species.

As the hybrid has a high frequency of parthenocarpic fruits and the yield is very much lower than the existing Tenera material, the direct use of F1 hybrid is commercially not viable. In fact, the present O originated in South America is not yet a commercially grown oil crop. Since no breeding work has been done on this wild crop, it would be a myth if people wish to make use of it directly of just hybridize it with the local high yielding materials. In fact, most plant breeders do not like to make use of wild relatives to improve a crop species unless the genetic variation exists within the cultivated gene pool has been exhausted (Frey, 1983). This is because this approach will destroy the finely tuned genetic background of the cultivated type and therefore will lower the means for many production characters. Judging from the present G breeding populations, the variations of polyunsaturates fatty acids within the populations is almost nil and therefore, it may be justified to transfer the good quality oil from O species through backcrossing rather than just aiming to produce F1 hybrids *per se* for commercial planting. The detailed procedures of the method for handling various types of characters can be found in most plant breeding text-books (Allard, 1960, Yap, *et al*, 1985).

The O species, besides having more unsaturated fatty acids than G, is also slow in height increment during growth and resistant or tolerant to diseases and pests (Meunier, 1987). Unlike the yield character, oil quality will be less susceptible to environmental interaction. Based on the genetic merits of this wild relative of oil palm, the backcross breeding programme aiming to improve the quality of the present palm oil to face the challenge in the near future is proposed. In this breeding programme, the backcross method used for handling quantitative characters is modi-

Oil composition	E. quineensis A	E. quineensis B	E. oleifera A	E. oleifera B	F1 C
C14:0	1.14	1.1	0.16	0.41	0.28
C16:0	35.59	44.0	17.20	33.32	30.37
C18:0	6.39	4.5	1.12	2.67	2.04
C18:1	41.34	39.2	59.88	50.52	53.30
C18:2	10.13	10.1	19.03	12.23	13.49
Total unsat:	52.17	53.3	78.91	62.75	66.79

Note: A : Data from Rajanaidu and Tan, 1985
B : Data from Tan and Oh, 1981
C : Data from United Plantation (unpublished)

fied and presented as follows :

Step O	*E. oleifera* (O)	x	*E. quineensis* (G)
1		F1 x G	
2		BC1F1	(Select the healthy plants and self to get BC1F2)
3		BC1F2	(Select for progenies with good oil composition and with general features of G and then backcross to G to get BC2F1)
4		BC2F1	(Select the healthy plants and self to get BC2F2)
5		BC2F2	(Repeat the procedures starting from step 3 for 2 to 3 cycles and then carry out the progeny test to select superior short G with good quality that derived from the donor parental population, (O).

The above backcross method can be applied to both Dura and Pisifera populations to develop "improved" Dura and Pisifera which have accumulated the desirable genes for oil quality from O. These improved Dura and Pisifera can then be used to produce improved DxP hybrids.

In this breeding programme, as we are more concerned about the transfer of good oil quality from O to G, the backcross progenies can be planted densely to cut down the cost of maintenance.

To use O as the recurrent parent is not recommended as to transfer the high yielding characteristics of G to O will be more difficult as oil or fresh fruit bunch yield is easily influenced by environmental factors. The heritability of yield is low in oil palm (Ahiekpor and Yap, 1983; Soh 1986). On the other hand, oil quality, like many other quality characters is less influenced by evironmental factors. Selection for progenies with desirable oil character for further backcrossing should be effective. This method has been successfully carried to improve the sweetness of the local papaya commercially known as Exotica (Chan, 1982). The method has also been applied to many other cereal crops (Allard, 1960).

DISCUSSION

Two genetic approaches for improving the oil palm industry are suggested in this paper. The first one is to improve oil yield through the exploitation of SCA effects of parents for hybrid seed production to cater for the existing palm oil industry. The second one is to increase the polyunsaturated fatty acids in the palm oil by transfering the good oil characteristics of Oleifera to the existing superior parents used for hybrid seed production by means of backcrossing. Hence, it can be said that the first method is aimed at producing palm oil for both the manufacturing and cooking oil industries and the second one is for the specific cooking oil quality demanded by certain consumers, especially for those in the temperate regions.

Genetic improvement of a crop is a long term process. The proposed strategies will take a long time to accomplish and therefore, it may not attract the interest of the private sector. PORIM, being an oil palm research institute, perhaps should consider it as a service to the oil palm industry.

The above approach is to satisfy further the preference of the consumers. However, it does not mean that the present palm oil is not goood for human consumption.

Our present marketing strategy always tries to satisfy the preference of consumers. It is good if the preference is commendatory. If the preference is without basis and will incur a lot of unnecessary cost which may increase the burden of consumers and the manufacturers, it may be better to educate the consumers. This alternative marketing approach may be a more aggressive one. Perhaps, time has come to plan a more aggresive marketing strategy to face the challenge in the year 2,000.

Many experiments have shown that palm oil is able to reduce the risk of arterial thrombosis, atherosclerosis and it does not raise the levels of blood cholesterol when compared to the normal diet. In addition, the crude palm oil provides a rich source of beta-carotene which is able to prevent nutritional blindness and offer protection against carcinogens present in our environment and diet. It is also a rich source of vitamin E. The consumers should be made aware of these findings so that they are not easily influenced by the baseless propaganda. In the past, because of the preference of the consumers, the valuable beta-carotene was removed during the process of obtaining RBD palm oil. In addition, since consuming more polysaturated fatty acids or polyunsaturated fatty acids would cause health hazard and palm oil has a good balance of these fatty acids, this would be a very good premium for planing our marketing strategies. Perhaps, in the year 2,000, palm oil will be marketed as a health oil and dominate the whole cooking oil trade.

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OTHER NEWS

1. Dr. M. S. Swaminathan, director general of the International Rice Research Institute (IRRI) and architect of India's "Green Revolution" has been awarded the first General Food's World Food Prize (1987) of US$200,000. Dr. Swaminathan introduced genetically superior grain varieties which doubled India's crop yield from 12 mil. t. to 23 mil. t. in four growing seasons; and turned the country from a land of famine to a land of plenty. He has played a key leadership role in a host of international conferences, scientific collaborations and societies (*eg.* SABRAO).
   Dr. Swaminathan, will head the list of speakers at the International Plant Biotechnology Network to be held at January 8-12, 1989 at Nairobi, Kenya.
   The 1988 World Food Prize is won by Dr. Chandler, who was also the founding director general of IRRI and AVRDC (Asian Vegetable Research and Development Control).
2. The Japanese government has named a panel of scientists to work out guidelines for field experiments with genetically manipulated organisms which are at present illegal in Japan.
   In a opinion poll 42% respondents said that rules were too slack, 10% too strict, 25% say just right. Only about 10% of respondents said they know what DNA was.
3. Univ. of Adelaide - seeks patent for transgenic pig which has extra growth hormone to increase food conversion efficiency hence grow faster.
   CSIRO (Australia) - applied patent for transgenic sheep which grows 30% more quickly. They are also trying to transplant 2 genes to speed up wool growth.
   They have also transferred a gene which codes for sulphur-rich aminoacids from the pea seed to the leaves of alfalfa plant to boost wool growth when fed to sheep.
4. Dr. James D. Watson who won the Nobal Prize with Francis Crick for unravelling the chemical structure of DNA has been appointed as the leader of a cooperative team to sequence the whole human genome. There are about 50,000-100,000 genes in the human genome and so far only 300 of them have been cloned.
   Last year, after a five year effort costing $11 m. the first rough map of the human genome pinpointing 404 RFLP markers, covering 95% of the length of the 23 human chromosome, was published.

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REFERENCES OF INTEREST

HISTOLOGY OF SOMATIC EMBRYOGENESIS FROM LEAF EXPLANTS OF THE OIL PALM ELAEIS GUINEENSIS

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ABSTRACT

Histological analysis was carried out during the sequence of events which lead to the obtaining of somatic embryos of oil palm. Calluses from the division of perivascular cells formed at the veins of young leaf explants. Subsequent proliferation of histologically similar nodules was by means of a cambium-like zone. Under certain conditions these calluses consisted almost entirely of meristematic cells. They then differentiated rapidly: the cambium-like zone fragmented, leading to protuberance in which the cells divide rapidly; epidermal structures which formed, with a network of procambial strands, and synthesis of storage lipids accompanied the formation of these embryo-like structures which developed into clumps of true somatic embryos, each with a shoot apex and a root apex. Other structures frequently observed during in vitro culture are also described and show that alternate pathways do exist. The structure and evolution of somatic embryos are compared to those of zygotic embryos. Storage lipids emerge as an early tracer of the satisfactory development of tissue towards somatic embryogenesis.

2. *Genetic Resources Sampling Strategy Based on Variance Components Estimated**

Rajanaidu, N., Palm Oil Research Institute of Malaysia, P.O. Box 10620, 50720 Kuala Lumpur, Malaysia.

Forty populations (P) of oil palm were sampled at random in Nigeria. At each site (population) five palms (families-F) were sampled and the seeds from each palm were kept separate and 12 seedlings (S) per family were field planted in a completely randomised design. ANOVA showed significant differences between populations (P), families (F) for most of the traits. The estimates of intraclass correlation of population (Tp) ranged from 0.28% families (T_F) 3.25%, and seedlings (1 − TF) 74-94%. Using the estimates of x, $\bar{\sigma}^2_p$, $\bar{\sigma}^2_F$ and $\bar{\sigma}^2_s$, a minimum sample size for N_p, N_F and N_S were computed. The results show that various combinations of N_p, N_F, and N_S could be chosen to attain the expected x at 95% probability.

*Poster paper presented at International symposium on Population Genetics and Germplasm Resources in Crop Improvement. U.C. Davis, August 11-13 1980.

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EDITORIAL

The one-day workshop and subsequent trial visit programme in Sumatra, Indonesia, from 25-31 November has been an informative and enjoyable trip for the ISOPB members who participated. The total number of participants numbered about 50-60. Malaysia sent a contingent of about 30, comprising mainly breeders with some agronomists and tissue-culturists. It is indeed heartening to note that members from faraway places i.e. Powell and Barr from Papau New Guinea, Okwuagwu from Nigeria, Meunier from France and Rosenquist from U.K. made it a point to join us in the programme.

The following are the titles of the papers presented at the Workshop (Summaries of the papers are also provided in this issue).

1. Improvement of the basic oil palm populations at IRHO – J. Meunier and J.C Jacquemard.
2. Preliminary results of the oil palm improvement programme using the reciprocal recurrent selection at the Marihat Research Station (P.P.M.) Indonesia – A.U. Lubis, R.A. Lubis, Akiyat, B. Nouy and J.M. Noiret.
3. Genetic progress obtained at Aek Kwasan (North Sumatra) through the exploitation of selected oil palm hybrid reproductions – B. Nouy, Asmady, L. Baudouin.
4. Improvement of tenera populations using germplasm from breeding programmes in Cameroon and Zaire – E.A. Rosenquist, R.H.V. Corley and W. de Greef.
5. Progress of Serdang Elmina and Serdang Avenue Deli dura breeding populations – N.Rajanaidu, V. Rao and Abdul Halim Hassan.
6. Selection progress in the Deli dura population – C.H. Lee, Y.Y. Yong, C. Donough and S.B. Chiu.
7. Progress and prospects in the Ulu Remis Deli dura breeding populations – Y.Y. Yong and K.W. Chan.

Discussions, as usual, were very lively.

The following were the trials visited at the various research stations.

A) Bah Lias (London-Sumatra) Research Station
   1) Expt. No. EG80210B – Multiplication of selected Gunung Melayu Dura.
   2) Expt. No. EG83221B – Source of Dura.
   3) Expt. No. EG83222B – Upgrading Gunung Melayu dura.
   4) Expt. No. EG83221B – Comparison of selected DxP progenies
   5) Expt. No. EG84225B – Oil palm spacing trial (Marchal fan design)
   6) Expt. No. EG79204A – Oil palm cultivar × density trial

B) Marihat Research Station
   1) Expt. No. BO 40 S – Hybrid O (Surinam) × G
   2) Expt. No. BO 35 S – Hybrid O (Brazil) × G
   3) Expt. No. BO 01 S – DxP Inter Origin
   4) Expt. No. BO 11 S – DxP PPM × Introduction
   5) Expt. No. BO 26 S – DxP PPM

C) SOCFINDO (Aek Kwasan)
   1) AK-GP 03-12 – D115D self × L2T self reproductions.
   2) AK-GP 03-12 – L404D self, L10D × D3D × L2T self reproductions

D) SOCFINDO (Bangun Bandar)
   1) Block 44/B – Oil palm clone observation plots.

E) RISPA
   1) Palm SP540
   2) Selfs of SP540
   3) Dumpy-dura selfs.
   4) O.P. Deli dura from Bogor Economic Garden
   5) Deli Dura × Tenera (SP540)
   6) Dumpy Dura × Tenera (SP540)

Some of observations and notes made by Dr. Vengeta Rao from these visits are given in this newsletter.

The Indonesians must be congratulated for a wonderful job done. The Workshop and field trips were organised efficiently. Guides were provided in all the trips to see to the visitors comfort and conveniences and in the field trips, trial write-ups and results for all the trials visited were given, indeed a kind and candid gesture, which all of us are very appreciative.

Editor

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Feature Articles

A. Visit to Oil Palm Research Stations in Indonesia. Some Observations and Notes.

Bah Lias Research Station (BLRS)

Bah Lias Research Station is located on Bah Lias Estate, one of the 19 estates of P.T.P.P. London Sumatra Indonesia (Lonsum).

The breeding material at the station has been assembled to allow BLRS to produce planting materials for its group. Elite breeding materials have been introduced from other countries for this purpose. The research programme is guided by Harrisons Fleming Advisory Services Ltd. with Mr. E.A. Rosenquist playing a principal role.

Some details of the trials visited during this trip are given below:-

Trial No.	Title	Remarks
EG 80.210 B	Multiplication of selected Gunung Melayu duras	Crosses between mother palms in the original 1984 short palm planting at G. Melayu. Two selfs have performed well but not all palms/progenies were short.
EG 83.221 B	Source of dura mother palms	8 Dami and 3 SOCFINDO D × P progenies, the latter from a 1952 planting. Dami progenies performed better and about 200 palms selected as mother palms. Pisifiera pollen were obtained from Dami.
EG 83.222 B	Upgrading of Gunung Melayu duras	D × D crosses between G. Melayu, Dami, SOCFINDO and Banting.
EG 83.223 B	Comparative D × P trial	G. Melayu, SOCFINDO and Dami duras with Dami and Banting pisiferas.
EG 84.225 B	Spacing trial using clones	Of the 4 clones in trial only UF10 was flowering normally.

The following important points were noted during the above visits:

1. Though the original G. Melayu palms were short, there was a great deal of variation in their sibbed progeny, both between progenies and within some progenies.
2. Because of low Mg status of the soils at Dami, leaf Mg levels were a selection criterion there. This was apparently reflected in the higher leaf Mg levels of Dami origin duras at Bah Lias estate. It was mentioned that Mg levels might be controlled by a single gene.
3. The Dami materials originated from OPRS Banting and hence some of the characteristics of the Banting duras and AVROS derived pisiferas were evident. The DxP were very vigorous and precocious with good bunch quality.
4. In the density trial (4 yrs old) with clones it was observed that in one clone, similar to clone 31A, a significant number of palms were tending towards a determinate habit with increasingly shorter, condensed fronds.

Marihat Research Station

The visit began with an introduction to the station by its Director, Ir. H.Adlin U. Lubis followed by a visit to their seed production facilities and field trials.

Marihat Research Station or Pusat Penelitian Marihat (PPM) is the property of PTP which is a large scale land development body in Sumatra. It has taken over the work of former Dutch companies such as BOCM, HVA and RCMA. Apart from the 10 ha well-equipped station at Marihat itself, there are sub-stations at Parindu (West Kalimantan) and Kalianta (Riau).

Marihat is the world's largest oil palm seed producer with an annual capacity of 20-25 million seeds. This volume must

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have come about through a rapid increase over a short period recently for some of their seed production facilities appear to have been unsystematically increased and others bulged at the seams. The modern dry heat method is used. Spikelets are retted in wooden boxes which are stacked together and periodically wetted by overhead sprinklers. The spikelets are beaten with wooden clubs a few days later to separate the fruits. Depericarping is achieved with a battery of eight 2-cage belt driven depericarpers. The depericarped seed is dried and further cleaned manually. The seed from each bunch is kept together and the number counted using a wooden board of 100 (10 × 10) holes. Small deformed seed are rejected during this counting. The heating room and germinating room were noticeably crammed with little space on shelves and between racks. A large number of workers sort the germinated seeds into bags of 250 each discarding poor seeds in the process. Seed is despatched in wooden crates lined with saw dust.

Five field trials were visited and the observations are summarised below:-

Trial No.	Year Planted	Remarks
BO 40S BO39S	1979 1978	Hybrid trials with Surinam and Brazilian oleifera. Where pollination was adequate the Brazilian oleifera hybrids gave better bunches with more % O/B. The palms were however massive and sterile. Surinam oleifera hybrids were more compact with crowns smaller than even *E. guineensis*. FFB yields were good but % O/B and I.V. lower.
BO01S	1973	Trial comparing 6 different pisifera sources (LaMe, Yangambi, Cameroon, Yaligimba, Zaire and PPM). The La Me × Deli gave the highest yields principally because of consistently higher FFB. It was also the shortest progeny. Deli × Yangambi and Deli × PPM also gave high % O/B.
BO 11S	1976	Trial comparing La Me, Dolok Sinumbah, Bah Jambi, Marihat and RISPA pisiferas. Overall the La Me source gave higher FFB although the best single cross used a RISPA pisifera (possible ex AVROS). This cross also had the highest extraction rate. Though the cross DS 29 D × L2T was shortest in the whole trial another L2T cross was not among the shortest.
BO 16S	1977	Trial comparing 25 DxP progenies using various pisiferas available at Marihat (DS 256P, DS 249 T, DS 245 T, BJ 216 P, BJ 237P, RS 18 T, RS 4 T, L2T, MA 840 T, MA 315 P). Overall RS 4T (RISPA AVROS) is clearly the highest yielder combining high FFB with high % O/B except in one combination.

There was opportunity also to visit the 1952 Surinam oleifera planting in the station complex. The palms are all procumbent with all the characteristic features of this particular oleifera. They were about 1 – 1 1/2 metres tall.

Rao, V.
PORIM

Editor's Note

Dr. Rao missed the visits to SOCFINDO (AEk Kwasan and Bangun Bandar) and RISPA; as he had to abort this trip to attend an important meeting back in Kuala Lumpur. In Aek Kwasan what was particularly striking was the high uniformity of the RRS "2nd cycle (i.e. within hybrid improvement using selfs) D × T hybrids both in habit and bearing behaviour. They represented the true sense of a hybrid variety. One could not help wondering whether clones could improve much upon this uniformity; and whether one could achieve significant yield improvement by selecting and cloning with such materials.

The new trial planting of Dumpy D × SP540 P at RISPA also exhibited the apparent uniformity of a hybrid variety. This was not unexpected as both parents were highly inbred.

The visit to SOCFINDO (Bangun Bandar) focussed on their clonal trial. Besides showing a clone (ex IRHO) with ramets exhibiting the "mantled" fruit syndrome, they also showed a clone which was highly susceptible to Orytes beetle attack while another clone was free of attack.

B. CLONAL PROPAGATION OF OIL PALM; Current experiences and Their Implications to Breeding and Cloning.

Paper presented at the Moet Hennessy-Louis Vuitton Colloquium on Advanced Technology and Plant Breeding Strategy

by

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ABSTRACT

The development of the tissue-culture technique to vegetatively propagate oil palm is a technological advancement in the improvement of the crop. It allows for the clonal propagation of elite palms, within the variable commercial mixed hybrid seedling populations. Projections of up to 30% improvement in oil yield have been made. This if achieveable will be a great improvement compared to the advancement made by conventional breeding of about 12-18% per breeding cycle of minimum 8 years' duration.

Recent findings and experiences indicate that to achieve the expected advantages of clonal oil palms, certain challenges still have to be faced. From the breeding and selection angle, firstly, heritable variation for oil yield within current commercial material is rather low to be able to achieve the high yield improvement expected by cloning the superior palms. Secondly the consequence of low heritability will result in unreliable palm selection. Thirdly field evaluation of the clones is mandatory and by the time reliable yield results are obtained, the next generation of newly-bred commercial materials will be available, diminishing the yield advantage of clones.

Challenges on the clonal propagation end include

i) Inefficiency in ability to clone palms
ii) Manifestation of variation in clones in terms of floral abnormalities and palm to palm yields.
iii) Long field testing cycle

The approaches in terms of breeding and cloning strategies to meet these challenges will be discussed.

With no significant natural means of vegetative propagation, the development of the tissue-culture technique to vegetatively propagate oil palm in the seventies and early eighties (Jones, 1974, Rabechault and Martin, 1976) can be considered as a technological advancement in the improvement of the crop. It enables elite palms within the variable mixed hybrid seedling population to be clonally propagated. Projections of up to 30% improvement in oil yield have been made. This, if achieveable, will be a great improvement compared to the advancement made by conventional breeding estimated at 12-18% per breeding cycle (Hardon, 1982, Gascon et al., 1987) which takes 8-10 years.

Recent findings and experiences indicate that to achieve the expected advantages of clonal oil palms, certain challenges still have to be faced both from the breeding and selection and clonal propagation aspects.

Challenges in Breeding and Selection

The popularly accepted figure of 30% expected increase in oil yield with clonal oil palms was based on the distribution (phenotypic) of individual palm oil yields within a typical superior hybrid population; the top 5% of which yielded more than 30% over the population mean. This projection presumed a very high heritability for oil yield. Recently Soh (1986) computed the broad-sense heritability for oil yield from such a typical seedling population and found it to be very low. Soh also computed the probability of capturing palms yielding 30% more than the trial mean and found it to be extremely small, and concluded that the expected oil yield improvement from cloning the top 5% of the palms within such a population would be around 13%.

The low heritability for oil yield was not unexpected because the parental populations of superior hybrid populations have been highly selected and inbred. The low heritability will also result in the unreliability of selecting individual palms for cloning.

The implications of the above findings to breeding and selection for cloning are:

a) Selection will be more efficient in hybrid populations derived from more outbred parental populations.

   This further emphasises the need to widen by outcrossing the genetic base of current parental breeding populations which are rather restricted.

b) Selection should be for a larger sample of selected palms (rather than a few palms) within the best family of superior hybrid populations derived from highly selected and inbred parents.

   This can be achieved by cloning adult palms of the best family from field trials or cloning the seedlings of the recreated cross of the best family.

c) Cloning the parents of the best family to produce biclonal F1 hybrid seeds.

   Both b) & c) would give rise to clones which would yield on average about the same (close to 13%) but with b) further selection improvement can be made after field testing.

d) Field evaluation of the clones is mandatory because of the unreliability of palm (ortet) selection.

   Reliable results of field evaluation can only be obtained after 7-8 years, by which time, the next generation of newly-bred commercial seedling materials will be available. The advantage of the clones will have to be judged against this new improved seedling materials rather than against the population from which the clones were derived.

Challenges In Clonal Propagation

The tissue culture technique in oil palm involves somatic embryogenesis from callus culture. The technique is still inefficient in that less than 5% of explants cultured can regenerate into plants. Seedlings are easier to clone than adult palms, and the percentage of adult palms which could be cloned, although varying with laboratories, generally averages about 20% (Paranjothy, 1985). Interaction effects between genotype and culture treatment (and perhaps time of explant harvest) are probably present.

The consequences of the above are the limitation in number of selected palms which could be cloned and the overdependence on a few embryoid lines per clone for commercial propagation.

Recently, Unilever (Corley, *et al.*, 1986) reported abnormal flower development i.e. parthenocarpy, androgyny, resulting in sterility in their clonal palms. Expressions of the abnormality was reported to be not evident in the first season planting. In the next season planting of the same clones (i.e. later subcultures) approximately 25% of the palms exhibited the symptoms. In the third season planting, more than 90% of palms were affected. Without getting into semantic arguments of whether the cause was of genetical or physiological origins (Soh, 1987) the phenomenon is definitely somatically heritable and stable. In this particular case, it is definitely a setback to oil palm clonal propagation efforts. It is perhaps a bit premature to conclude that this is a general phenomenon although this abnormal flowering has been observed in the clones of other laboratories on a very minor scale. Apparently there are also clonal differences in susceptibility to the disorder (Eeuwens, 1988).

Many laboratories are adopting research approaches which reduce or avoid the use of likely causal agents and procedures of the disorder.

a) Avoidance or reduction in the use of 2, 4-D
b) Avoidance or reduction of auxin in embryoid proliferation
c) Avoidance and reduction of cytokinins or use of cytokinin antagonists in countering endogenous cytokinins (Paranjothy – pers comm.) in embryoid proliferation
d) Avoidance of growth regulators for embryoid multiplication
e) Improving culturing efficiency to reduce length in culture
f) Direct differentiation of embryoids on explant to avoid the callus phase
g) Improving efficiency of cloning to obtain more clones and embryoid lines so as to avoid overdependence on a few embryoid lines per clone for intensive (and prolonged) multiplication
h) Cloning the parents for biclonal F1 seed production
i) Recloning the first ramets (clonal plantlets) *in vitro* or in the field
j) Cryopreservation of embryoids

The last three approaches share the common objective of reducing the need to intensively multiply a few embryoid lines which could lead to the disorder.

All the above approaches are likely to meet the common problems of restriction in the number of clones and ramets which could be produced at any one time; and the need for adequate field testing to check for clonal fidelity. As evident from Unilever's experience this may require testing over a number of seasons.

In a very recent re-examination (Lee, pers.comm) of the clonal palms of Unilever's first season planting there were evidently some signs of abnormal flowering. Furthermore there were wide tree to tree variation in yield in some plots for the clones. This could be related to the abnormal flowering phenomenon or it could be another expression of somaclonal variation. In any case, this implies the need to observe clones planted in the field not only for three years to check for abnormal flowering but perhaps for a longer period to check for yield stability besides for clonal differences in oil yielding ability than the 4-5 years commonly used for seedling materials. The clones may also have to be tested over different environments, as clone-environment interaction effects are likely to be present. All these result in cumbersome and expensive testings.

Meeting the Challenges

The need to widen the genetic base of the parental breeding populations whether for the production of hybrid seedlings for commercial planting or for commercial propagation cannot be questioned for it is the breeding axiom that selection improvement is only possible if there are genetic differences between plants. Breeders are actively pursuing this.

With exploitation of the clonal propagation technique in view,cloning of the parents of the best family for biclonal F1 hybrid seed production approach appears to be the more attractive approach at the moment. The likely advantages of this approach are the lack of need to intensively multiply the few embryoid lines; the ability to check and select the parental clones before their use in seed production; deleterious or undesirable mutations arising from tissue culture may be self-screened out in the sexual process or masked by the dominant allele from the other parent in the production of the hybrid seed.

The challenge to the tissue-culturist is to be able to clone the specific combining parents of the best crosses. By media, physiological and physical environment manipulations cloning efficiency of palms could be substantially improved to more than the current 20% success. Meanwhile a way around this is to clone good general combining parents instead of specific combining parents with only expected minimal sacrifice in yield selection improvement.

The challenges facing the cloning the elite palm approach appear more involved. Efforts to clone more palms from the best family constitute no problem and may be obligatory in view of the low cloning success. The possibility of obtaining variant ramets is of more critical concern.

Many tissue-culturists recognise that variant forms invariably occur in the tissue culture propagation of plants (Skirvin, 1978, Hardon 1988). It is a question of when it occurs and the degree of manifestation, and these vary with different genotypes and different cultural conditions. Even in orchids, the majority of the species cannot be commercially propagated *in vitro* because they regenerate variant forms (Hew, 1988). Successful commercial *in vitro* propagation apparently depends on the critical choice of genotype, the protocol and knowledge of production level per culture permissible (i.e. number of subcultures) to achieve a minimum acceptable level of variant production. Recloning appears to be the rule and there is no indefinite or extended propagation of the cultures.

As such, a similar approach needs to be developed for the oil palm for every clone produced. Successive batches of the same clones will have to be raised until flowering in large nursery polybags or in the field, to determine its culture length stability. Certain of these batches will have to be field planted and evaluated also for yield stability. These will be a cumbersome and expensive exercise because being a perennial tree crop, the oil palm occupies much space and time. The development of early screening aids using isozyme and RFLP analysis at the laboratory or nursery level will reduce the effort considerably. Unilever (Eeuwens, 1988) and PORIM (Palm Oil Institute of Malaysia) are pursuing this but it may require some time and effort to identify the required isozyme and RFLP markers.

After the clones have been selected from the field evaluation, and their lengths of subculturing stability determined, new cultures of these clones will have to be generated for commercial propagation. Cryopreserved embryoid cultures can be used, but the number of base embryoids for multiplication may be limited and again the fidelity of clones derived from cryopreserved embryoids, will have to be ascertained. Recloning, from the original ortet palm or ramets in the laboratory or in the field, seems the better approach. Recloning from the ramets in the field trials which have been shown to be stable and high yielding would be the best choice as the number of embryoids obtainable will be much higher.

In short, the suggested strategies to exploit the clonal propagation technique in the improvement of the oil palm are:-

i) select hybrid families and palms derived from more outbred parental populations, and a greater number of families.
ii) clone the parents of the best hybrid family for biclonal F1 seed production.
iii) for cloning the elite palm approach, a larger sample of palms within the best family will have to be selected and cloned to account for the unreliability of individual palm selection and low cloning efficiency.
iv) each successive subculturing batch of each of a large number of clones will have

to be tested in the nursery and the field for their clonal stability in terms of flowering and yielding behaviours, and the period of subculturing stability determined.

v) recloning from the field ramets of the selected clones for further adaptability and agronomic trials and for commercial propagation.

The characteristics eg. growth and bearing habits of individual clones will have to closely studied and trials on how best to package the various clones for commercial planting will perhaps need to be carried out.

As evident from the discussions, we are still very much in the early stages in the commercial exploitation of the clonal propagation technique for the oil palm. Much research work on tissue culture with respect to protocol development and genotype response and particularly field testings, still needs to be done. It will probably be at least 10 years before oil palm clonal propagation becomes a full-fledged technology. Even then the genotypic range of clones produced would likely to be more restricted.

Lastly the clones finally selected for commercial propagation will need to possess distinct advantages e.g. higher yield, pest, disease or stress resistance, better quality oil, over the improved seedling materials currently available then.

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NEWS

A. Conference News

NIFOR – In conjunction with its 50th Anniversary Celebration, NIFOR is organising an International Conference on Palms and Palm Products to be held in Benin City, from 22nd-25th November 1989. A number of ISOPB members are expected to attend this meeting.

PORIM – Similarly, PORIM is organising the 1989 PORIM International Palm Oil Development Conference to be held in Kuala Lumpur from 5th to 9th September 1989, as part of its 10th Anniversary Celebration. Many international oil palm scientists are expected to congregate in Kuala Lumpur.

ISOPB – To tap the possible participation of overseas scientists present at the 1989 PORIM International Conference; ISOPB is organising an International Symposium on Application of Statistics to Perennial Tree Crops Research, to be held on 8th and 9th September 1989, also in Kuala Lumpur. A notable researcher from University of Kent associated with the East Malling/Pearce group will be delivering the keynote address. This Symposium will be followed up with a lecture course as well. Further news will be forthcoming.

ISOPB will be holding its General Meeting on September 9, afternoon immediately following the Symposium. A dinner party is also planned.

B. Palm Oil/Oil Palm News

Abnormal Oil Palm Clones

More reports of abnormal oil palm clones have been made and involved materials from all major oil palm tissue-culture laboratories. Apparently the incidence of abnormal clones was not necessarily tied with the use of phytohormones during the embryoid multiplication stage.

Apparently date-palm tissue-culture propagation was also facing similar problems.

The 'good' news from this 'bad' news is that many laboratories are now "sharing their secrets" on this subject. This was not so apparent before.

IUNS Says No To Olestra & Simplese

The Internationsl Union of Nutrition Science (IUNS) in its first meeting on August 19-20, 1980 in St. Andrews, Scotland, dealt with the biological role of fatty acids in human nutrition.

IUNS did not approve of the use of fat substitutes e.g. Simplese, Olestra, especially for children because they would cause reduction in intake of vitamins A,D,E and K which would result in deficiency diseases e.g. growth depression in children.

IUNS was particularly concerned that nutritional guidelines and advice which had so far been given to the laymen by people and organisations have been professionals, who knew little about lipid nutrition, and felt that it should take up the task of educating doctors and dietician etc. The meeting agreed that while it is recommended that the consumption of fat should be reduced from 40% to 30% energy, preferably by lowering saturated fat intake, for people in the developed countries, for the Third World countries, increased energy from fat should be the recommendation. Increase in consumption of polyunsaturated fatty acids (PUFA) should be coupled with increased consumption of vitamin E because of the concern about the peroxidation of PUFA. Similarly it also expressed disapproval of consumption of fish oil concentrate in capsules but would not object to fish oil consumed in its original form in fish meat where the natural antioxidants and preservatives are intact.

PORIM TAS News Oct. 1988

Health Implications of Consuming Hydrogenated Fats

Survey of literature showed that the consumption of unnatural trans fatty acid formed during the hydrogenation of polyunsaturated fatty acid process (in making margarine) is undesirable.

i) Trans isomers of PUFA, in contrast to the natural cis form is not only devoid of essential fatty acid activity but its very presence appreciably inhibits the elongation of cis linoleate into arachidonate in the biosynthetic pathway in the body.
ii) Trans fatty acids incorporated into biological cell membrances will reduce their permeability, thereby altering normal cellular functions
iii) There ia an increase in blood cholesterol levels of animals fed with diets high in trans acids.

For most applications and by proper blending of products, palm oil does not need to be hydrogenated, thereby eliminating the risks of unnatural trans fatty-acids.

PORIM Tas News Oct. 1988

Genetics & Biotechnology News

Patenting

The U.S. Congress has passed The Transgenic Animal

Patent Reform Act, which would make it illegal to sell germ cells, semen, or embryos of a patented trangenic farm animal without making royalty payments. However, farmers would not have to pay royalties on the offspring of that animal when using the animal for breeding or when selling the animal.

Discovery of a "Second Genetic Code"

It is well known that different kinds of transfer RNA each carrying one of the 20 different amino acids, assemble the acids in chains where sequences are specified by messenger RNA. Until this recent discovery by researchers in MIT, it is not known how different forms of tRNA pick up specific amino-acids for assembling into proteins. The discovery shows that a certain small portion of a particular kind of tRNA serves as a code and makes it stick to a particular amino-acid. While the tRNA can be manipulated as with DNA, the changes would drastically disrupt the protein "assembly line" killing the cell. As such scientists could think of little practical uses for it at the moment.

Does Cytoplasmic Recombination Occur?

A group of Hungarian researchers proposed that extensive genetic recombination occour among chloroplasts of *Nicotiana tabacum* × *N. plumbaginifolium* protoplast fusion products. Allelix Agriculture researchers however failed to detect chloroplast or mitochondiral genome rearrangements in over 400 *Brassica napus* plants regenerated from single protoplasts, protoplast fusion products and anther cultures.

Plant Hormones Regulate Gene Expression

Although suspected all along, it is only recently that direct evidence of plant hormones operating by stimulating expression of genes was obtained. Dupont scientists have transferred a wheat promoter gene into rice protoplasts and have detected expression and normal regulation of the gene when it is specifically induced by ABA (abscisic acid).

In Vitro Plant Products

Production of the following plant products by *in vitro* culture has been reported.

1Ficin	– from callus cultures of *Ficus carica*. This enzyme is similar to papain in some of the industrial applications.
Colchicine	– from callus cultures of *Colchicum antumnale*. This drug is used to treat gout and to induce autopolyploidy in plant breeding.
Anthraquinones	– from callus cultures of *Cassia podocarpa*. These chemicals are used as pigments and as laxative.
Forskolin	– from suspension cultures of *Coleus forskoliti*. This drug is used to treat against high blood pressure, intraocular pressure and thrombocyte aggregation.

Transgenic Virus Resistant Plants

Transgenic plants expressing coat protein genes from viral pathogenes e.g. tobacco mosaic virus, tomato, mosaic virus, cauliflower mosaic virus, alfalfa mosaic virus, cucumber mosaic virus and potato virus X are not only resistant to the respective virus but also to related visuses as well i.e. "cross-protection"

Engineered Insect Resistant Crops

Pioneer Hi-Bred is cooperating with Agricultural Genetics Co. of Cambridge, U.K. to incorporate an insect resistance gene into its seed products. The gene codes for the cowpea trypsin inhibitor which prevents the breakdown of certain proteins in the insect digestive system causing insects to starve. Incorporation of the gene into corn is targeted to protect crops from both the European corn borer and corn rootworms.

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Abstracts of papers presented at ISOPB Seminar "Progress of Oil Palm Breeding Populations" held on 25th November 1988 at Pematang Siantar, Indonesia.

1. Meunier, J. and Jacquemard, J.C. Improvement of the basic oil palm populations at IRHO.
   IRHO uses a reciprocal recurrent selection method to improve oil palm. In this scheme, all the ecotypes used have been divided up into two groups, A and B, which thus constitute the basic populations of the selection programme. Improvement of these two populations is achieved through selection combining a phenotypic choice of individuals based on their characters with high heritability and selection based on the value of their progenies for low heritability characters. The processes of recombining selected individuals and creating new improved basic populations serving as a basis for a new improvement cycle are described.
2. Lubis A.U., Lubis R.A., Akiyat, Nouy B. and Noiret J.M. Preliminary results of the oil palm improvement programme using reciprocal recurrent selection at the Marihat Research Station (P.P.M) Indonesia are presented.
   In 1974, the Marihat Station launched a substantial oil palm improvement programme, based on a reciprocal recurrent selection scheme. Results available made it possible to assess the hybrid value of parents from 7 tenera/pisifera populations and from different dura origins.
   Tenera between-population variability is considerable. The La Me and RISPA populations had the best general combining abilities (GCA), and when crossed with several PPM's dura gave very good yields. Other populations with higher variability, provided interesting crosses, though fewer in number. Differences also existed with respect to vertical growth, susceptibility to Crown Disease and iodine value.
   Variation between dura origins was lower and the choice of origins was less crucial.
   Bunch number seemed to be a predominant factor in the determination of oil production.
   These results enabled parent GCA to be assessed. These parameters were used as a criteria in constituting an improved population. GCA also exploited, along with SCA, in seed production. It should be possible to increase oil yield by 25%, FFB by 18% and for extraction rate by 5.5%.
   The analysis results described in this article are incomplete because, part of trials has yet to be finished. Some crosses such as Marihat, D. Sinumbah and others were slow starters; while La Me, Yangambi and RISPA gave high early yields.
3. Nuoy B., Asmady L and Baudouin L. Genetic progress obtained at Aek Kwasan (North Sumatra) through the exploitation of selected oil palm hybrid reproductions.
   Sixteen comparative trials, testing 360 crosses, have been planted at Aek Kwasan. They form part of the second cycle in the oil palm improvement programme involving reciprocal recurrent selection developed by IRHO. The parents are derived on the one hand from the self of two parents of La Me origin (L2T and L451 T) and on the other hand from the selfs or crosses between Dabou Deli and Socfin Deli parents.
   The results confirmed that by selfing or crossing the parents of a hybrid, it is possible, on average, to reproduce its characteristics. In addition, considerable variability still exists between crosses belonging to the same hybrid reproduction.
   The relationships between oil production and its components were different from those observed in the first cycle, the predominant relationship being the extraction rate rather than bunch number with oil yield.
   Substantial genetic progress was obtained through this second cycle, with a minimal reduction of genetic diversity. This progress is passed on the seed production through parent selfing or recombination. It will also make it possible to obtain further progress in the third cycle by recom-

bining the tested parents of various origins.

4. Rosenquist E.A., Corley R.H.V. and de Greef W. Improvement of tenera populations using germplasm from breeding programmes in Cameroon and Zaire.
At Lobe in Cameroon about 400 oil palm progenies were planted in 32 trials between 1966 and 1971. At Binga in Zaire 470 progenies were planted between 1970 and 1979. In Cameroon the emphasis was on further development of the Ekona population, breeding of which had started in 1933 and at Binga on breeding from third generation Yangambi material, but at both stations other sources were used including NIFOR, IRHO and Deli.
Current breeding programmes at Lobe and Binga carry this genetic material into another generation and the resulting trials are being planted in Colombia, Indonesia, Malaysia, Papua New Guinea, Thailand and Zaire.

5. Rajanaidu N., Rao V. and Abdul Halim H. Progress of Serdang Elmina and Serdang Avenue Deli Dura breeding populations.
The F1 and F2/F3 generations of Serdang Avenue *duras* and Serdang Elmina *duras* were crossed to AVROS *pisiferas* and their performance was compared. In general, DxP progenies derived from Serdang Avenue palms had slightly higher bunch yield and bunch number and lower average bunch weight as compared to Elmina Selections. The oil to bunch values of Elmina duras were lower than Serdang Avenue duras and the hybrids. However, the D × P progenies derived from these had oil to bunch values comparable to those of Serdang Avenue palms.
The data indicated that there were genetic progress in bunch yield (9%) and oil yield (7%) in the D × P materials from use of F1 to F2 dura materials.

6. Yong Y.Y. and Chan K.W. Progress and prospects in the Ulu Remis Deli Dura breeding populations.
The Ulu Remis Deli Dura (URD) breeding population developed by Guthrie Research Chemara has been widely distributed and commercially exploited for the selection of dura mother palms in Guthrie and other breeding stations, both locally and overseas, for the commercial production of the Dura × Pisifera (D × P) oil palm seeds.
The popularity of the URD stems from its proven general combining ability with the African teneras/pisiferas. This paper traces the development and selection progress of the URD breeding populations from their establishment in Guthrie in 1929 with the descendents of four Bogor palms planted in 1848 to the present day advanced generations. Comparisons between the first generation (F1), second generation (F2) and third generation (F3) progenies had indicated that F2 and F3 progenies had respectively shown improvements of 38% and 54% over that of F1 progenies for FFB yield. These were achieved through increases in bunch number than in bunch weight. Higher fruit to bunch, mesocarp to fruit and oil to bunch were observed in F3 progenies than in F2 progenies. The prospects of further improvements in the URD through selection and introgression of the F3 progenies are discussed.

7. Lee C.H., Yong Y.Y., Donough C. and Chin S.B. Selection progress in the Deli dura population.
Four groups of Deli duras representing unselected, first and fourth generations of selection were evaluated. The first generation of selection resulted in a selection progress of 12.4% and 19.4% in FFB and oil yield respectively. Subsequent generations had achieved a selection progress of 8.8% and 11.7% per generation for these two characters. Mesocarp to fruit was significantly increased while the shell and kernel to fruit were significantly reduced in the advanced Deli dura population. The CV of yield and its components and trunk height were reduced after four generations of selection. Comparison of third and fourth generation Deli duras crossed with BM119 pisiferas indicated no selection progress for FFB yield but a 6.4% increase in oil yield.