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EFFECTS OF SEVERE LEAF PRUNING ON OIL PALM, AND ITS POSSIBLE USE FOR SELECTION PURPOSES

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RINGKASAN

Kesan akibat pemangkasan daun dan pelepah yang berlebihan ke atas pertumbuhan dan pengeluaran hasil kelapa sawit telah dikaji dan menunjukkan bahawa ianya didapati hampir sama mutunya dengan kesan akibat penanaman pokok yang terlalu rapat jaraknya. Percubaan penurunan baka yang berbagai jenis juga berbeza dalam tindakbalas terhadap pemangkasan. Kemungkinan menggunakan pemangkasan sebagai memalsukan penanaman yang terlalu rapat demi untuk pemilihan baka telah juga dibincangkan.

INTRODUCTION

High density planting of progenies selected for their performance under such conditions has been suggested as a possible method of increasing oil palm yields per unit area (CORLEY *et al.* 1971; CORLEY, 1973). Progenies with a high bunch index (see below) and low rate of vegetative dry matter production were thought likely to be best suited for this purpose. Experiments in which selected progenies will be planted at a range of densities are now being planned, and should confirm whether these suggestions are valid. However, it will probably not be practicable for every progeny in a breeding programme to be planted at several densities, so some methods must be found for estimating the optimal density for progenies planted at a single density only. CORLEY (1973; also CORLEY, 1976a) has suggested that an estimate of the optimum might be obtained from measurements of various parameters at a single, lower than normal density. An alternative approach to the problem is discussed in this paper.

Considered superficially, the effects, on palm dry matter production, of high density planting and of severe leaf pruning might be expected to be similar; with the former, the lower leaves are rendered photosynthetically inactive by shading, while with the latter these leaves are removed altogether. Both treatments are found to have similar overall effects on the partition of dry matter by the palm; yield is reduced, but the amount of dry matter used for vegetative growth is not much affected (CORLEY, in press b). Both treatments also have similar effects on yield components; mean bunch weight is reduced, abortion rate is increased, and the ratio of female inflorescences to males is reduced (CORLEY *et al.*, 1973; CORLEY and HEW, 1976).

In view of these similarities, I considered that the responses of different progenies to severe pruning might provide some indication of the behaviour to be expected from the same progenies at high planting density. As the first step towards investigating this, we superimposed a pruning treatment upon an existing progeny trial, as described below. The progeny trial formed part of the breeding programme of Chemara Research Station.

MATERIALS AND METHODS

A trial containing 25 *dura* x *pisifera* progenies was chosen; the design consisted of 34 replications with single palm plots. Adjacent replications were paired, and one was pruned every six weeks to leave sixteen leaves per palm, while the other was unpruned, with an average of about 40 leaves per palm. As considered here, the experiment thus becomes a split plot design.

with two treatments (pruned and unpruned), seventeen replications and each main plot split to 25 single palm sub plots. It was not possible to include guard rows between pruned and unpruned plots, so unpruned palms bordering pruned plots may have benefitted from reduced competition from their neighbours. The progenies were completely randomised within main plots, so the major effect of this should be to increase the error variance in the statistical analysis.

The progenies were obtained by crossing each of seven *pisifera* male parents with from two to five *Deli dura* female parents. Results could thus be analysed according to the North Carolina Model 1 design, but I have simply partitioned the "progeny" and "progeny x pruning" mean squares into 'between males" and "between females within males" fractions. Inheritance of growth parameters is discussed in more detail by HARDON *et al.*, (1972).

Rates of dry matter production were estimated, following CORLEY *et al.*, (1971), from non destructive measurements, during 1973 and 1974.

RESULTS

The effects of pruning *(Table 1)* were similar to those described elsewhere (CORLEY, 1976b; CORLEY and HEW, 1976). Yield was severely reduced, with decreases in both bunch number and mean bunch weight, though oil to bunch weight ratio was not affected. Bunch index (the proportion of total dry matter used for bunch production) was reduced, and leaf area ratio (F, the ratio of new leaf area produced to vegetative dry matter produced in the same period) was increased. Vegetative dry matter production (V) was slightly lower; data from CORLEY, (1976b) also showed a slight reduction in V, though in that trial the difference was not statistically significant. The 1973 data gave generally similar results to those in *Table 1.*

TABLE 1. EFFECTS OF PRUNING ON GROWTH PARAMETERS AND YIELD COMPONENTS (1974 DATA)

	Unpruned	Pruned	s.e.
Yield of fruit (dry wt./palm/yr.)	90.4	31.7	1.25
Mean bunch weight (kg. dry wt.)	9.28	6.86	0.17
Bunch number per palm per year	10.8	5.3	0.19
Vegetative dry matter (kg./palm/yr.)	104.2	100.2	1.34
Bunch index	0.45	0.23	0.006
Leaf area ratio (m^2/kg.)	1.99	2.24	0.029
Oil/fresh bunch weight (%)	23.6	23.8	0.48

Table 2 shows that significant variation between progenies occurred for all parameters. The progeny x pruning interaction was significant for yield and V, while either the females x pruning or the males x pruning component was significant for all parameters. 1973 results were similar except that the progeny x pruning interaction for bunch index was highly significant. *Table 3* shows the mean effect of pruning on each parameter (from *Table 1)* and the range of effects between different progenies.

TABLE 2. ANALYSIS OF VARIANCE+ FOR EFFECTS OF PRUNING ON YIELD AND GROWTH PARAMETERS (1974 DATA)

Parameter:		Yield	V	Bunch index	F
Source	df		Mean squares		
Pruning	1	734235***	3487*	10.50***	13.47***
Main plot error	16	659	755	0.013	0.353
Progenies	24	2327***	980***	0.0486***	0.5359***
Among males	6	5173*	408	0.0896	0.2091
Among females	18	1378*	1171***	0.0349**	0.4782**
Progeny x pruning	24	1453*	468**	0.0208	0.0694
Males x pruning	6	519	480	0.0099	0.1501*
Females x pruning	18	1764**	464*	0.0244*	0.0424
Sub plot error	750	821	241	0.0147	0.0538

+ Adjusted for missing plots

* $p < .05$

** $p < .01$

*** $p < .001$

TABLE 3. EFFECTS OF PRUNING ON GROWTH PARAMETERS, AND THE RANGE OF EFFECTS BETWEEN DIFFERENT PROGENIES (1974 DATA)

Parameters:	Yield	V	Bunch index	F
		Percentage change due to pruning+		
Mean	–65	4	–50	+13
Range	–46 to –77	+7 to –19	–27 to –62	+2 to +21

\+ A decrease in a parameter is given as negative, increase as positive.

DISCUSSION

The effects of pruning and of high density planting are broadly similar, as was noted in the introduction. *Table 4* shows that yield, bunch number, male inflorescence number, bunch weight, total dry matter production, vegetative dry matter production and bunch index are all

TABLE 4. COMPARISON OF EFFECTS OF SEVERE PRUNING AND OF HIGH DENSITY PLANTING

	Pruning+	High density‡
	Change (%) caused by treatment	
Yield of fruit	–65	–42
Oil/bunch weight	+ 1	0
Bunch number per palm per year	–51	–23
Male inflorescence number/p/yr.	+44	+10
Mean bunch dry wt.	–26	–15
Total dry matter production	–32	–24
VDM	– 4	– 5
Bunch index	–50	–24
Leaf area ratio	+13	– 3
Mean leaf area	+ 3	+ 1
Mean leaf dry wt.	– 9	+ 2
Leaf production per palm per year	+ 7	– 9
Trunk height increase	– 2	+14

+ "Pruning" compares 40 and 16 leaves per palm (from present trial, and data of Corley and Hew, 1976).

‡ "High density" compares 145 and 227 palms/ha (from data of Corley, 1973).

altered in the same direction by both treatments. The size of the effect depends on the severity of the treatments, so only a qualitative comparison can be made, but, for example, bunch number is more affected than bunch weight in both instances. When vegetative growth is examined in detail, however, differences appear. The most obvious one is that high density has an "etiolation" effect, causing greater annual trunk height growth, whereas pruning does not affect this. Pruning increases leaf area and decreases leaf dry weight, resulting in a higher leaf area ratio, but high density has little effect on these parameters. Leaf production rate is increased by pruning, but decreased at high density.

There appears to be a considerable range of response between progenies for the different parameters *(Tables 2 and 3)*. Progeny mean yield over two years under pruning ranged from 54 kg dry weight per palm per year down to 21 kg, and was positively correlated with unpruned bunch index ($r = 0.41$, $p < 0.5$, 23 df). This correlation can be considered an analogous to the suggestion (HARDON *et al* 1972) that high bunch index progenies should be best able to maintain a high yield per palm at high planting density. However, the best progeny under pruning, which yielded 64 percent more than the overall mean, and 42 percent more than the next best progeny, had only the second highest unpruned bunch index, while the next best three progenies all had below average unpruned bunch indices. The main feature common to these progenies appeared to be their relatively high net assimilation rates under pruning, with consequently only a small reduction in total dry matter production caused by pruning. This may perhaps indicate that in these progenies the photosynthetic activity of the remaining leaves was able to increase in response to the increased demand caused by leaf removal.

Another point of interest is that in some progenies vegetative dry matter production is appreciably reduced by pruning, in one instance by 19 percent. We might anticipate that the reduced V would leave more dry matter available for bunch production, and there was a slight negative correlation in 1974 ($r = -0.39$, $p < 0.1$, 23 df) between progeny means for yield and V under pruning (but not in 1973). However, the progeny showing the greatest reduction in V had only average yield under pruning in 1974 (and the lowest yield in 1973). In the unpruned state this progeny appeared to have no particular distinguishing features and, as with the best progenies discussed above, probably could not have been recognised if the pruning had not been done.

CONCLUSION

Severe leaf pruning has effects on the palm which are similar to, but not identical with the effects of high density planting. Progenies differ in their response to pruning, and the general trend of progeny x pruning interactions is similar to expected progeny x density interactions (though no progeny x density trials have yet been reported). However, some exceptional progenies were found, which could not have been recognised if the pruning had not been done. Thus pruning appears potentially useful as a selection tool, but it must first be established that the best progenies under pruning will also perform well at high density. The next step, therefore, must be to plant the same progenies both in a density trial, and at normal density for a pruning trial, so that responses can be directly compared.

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SUMMARY

The effects of severe leaf pruning on growth and yield of the oil palm are examined, and shown to be qualitatively fairly similar to the effects of high planting densities. Different progenies differ in their response to pruning, and the possibility of using pruning to simulate high density planting for selection purposes is discussed.

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