METHODS OF UNDERPLANTING IN SENILE COCONUT PLANTATIONS

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A number of coconut plantations in Ceylon have reached a condition of total senility and show a progressive decline in yield. The age at which a coconut palm reaches this condition cannot be defined precisely as a number of environmental factors are involved. A reliable index is the yield: if production decreases gradually in spite of regular cultivation, balanced manuring and good management, and in the absence of any adverse effects due to pests and diseases, then it could be presumed that the decline is due to the age of palms. A field trial to study the relative merits of three systems of underplanting was laid down in May 1950 and the data collected are presented in this paper.

No attempt is made to discuss regeneration of coconut plantations in general. Some of these aspects have been referred to in the C.R.I. Bulletin No. 5 by W.V.D. Pieris. However, it is pertinent to refer to a system adopted in some progressive estates of a process of selective thinning of palms from the time the seedlings are transplanted. Young palms that are not vigorous and adult palms that are poor yielders are uprooted periodically and selected seedlings are planted at the same sites. By such a process of elimination of weaklings, the yields could be stepped up. The palms will vary considerably in age and the question of total senility of a plantation would not arise.

DESCRIPTION OF THE EXPERIMENT

The experiment was carried out at Bandirippuwa Estate on a block of land with senile palms. Planting distances were not very regular with a density of 64 (approx.) palms per acre. Soil was largely a sandy loam, liable to water-logging. Three methods of underplanting were tried out:

A. Late thinning.—Underplanting with the old stand of palms remaining and removing the latter 8 years later.

B. Gradual thinning.—Underplanting and removing the old stand of palms gradually during the first 8 years. In this instance 12 per cent of the old palms that were very close to the new planting sites, were removed before transplanting seedlings. Thereafter, the old palms were removed yearly and the percentage of old palms remaining at the end of each year was as follows: 1st year —82, 2nd year—72, 3rd year—60, 4th year—42, 5th year—32, 6th year—20, 7th—8, 8th year—none. During the first two years all the old palms within 8 feet from the new planting sites were removed, and thereafter removal was largely based on yield of nuts per palm.

C. New clearing.—Planting after the removal of the old stand of palms completely.

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The design of the experiment was a randomised layout, with 7 replications and 25 palms per plot, each block being separated by a guard-row of palms. All seedlings transplanted were selected. Planting distance was 26 × 26 feet on the square system. Manuring and cultivation were done regularly.

The following data per palm were collected: leaf production during the first five years, flowering-period, yield of nuts and weight of husked-nuts. Analysis of variance was done after appropriate transformations of raw data.

RESULTS

Leaf Production

The number of leaves produced per palm, excluding leaves not dissected, was scored at the end of each year and the data from the first to the sixth years are given in Table 1. The six years data have been treated to a combined analysis of variance and the following factors were significant: blocks ($P = 0.05$), treatments ($P = 0.01$), years ($P = 0.001$), years × treatments ($P = 0.001$). As both the treatment and the interaction years × treatments variances are significant, it is sufficient to study the interaction.

TABLE 1

Mean number of leaves produced per 100 plants each year

Treatment	*Year after transplantation*					
	1st	*2nd*	*3rd*	*4th*	*5th*	*6th*
New clearing	432	659	722	878	1,121	1,119
Gradual thinning	412	607	652	755	944	964
Late thinning	416	594	628	693	818	832

Critical difference between treatments each year = 31

The pattern of yearly leaf production during the first six years of growth of the young palms was related to the treatment type. In the first year after planting, leaf production was practically the same for all treatments. The plants in the new clearing treatment have produced significantly more leaves than those in either of the other two treatments, from the second to the sixth year. Leaf production between gradual thinning and late thinning treatments has been in favour of the former from the fourth year onwards; differences between the two treatments during the second and third years, being not significant. As far as leaf production of a young palm during the first six years are concerned, the three systems of underplanting could be placed in the following order of merit: (i) new clearing, (ii) gradual thinning and (iii) late thinning.

Flowering-period

The flowering-period of a palm has been taken as the period from date of transplanting a seedling to the emergence of the first spathe on the palm. The percentage of palms in flower, cumulative for each year is given in Table 2.

TABLE 2

Percentage of palms in flower

Treatment	Year after planting					
	5th	6th	7th	8th	9th	10th
New clearing	11.4	39.4	60.6	83.4	89.7	94.3
Gradual thinning	2.9	21.1	43.4	65.1	74.3	78.3
Late thinning	1.1	11.4	24.0	44.0	54.9	67.4

The variance ratio for each year was significant indicating that the type of treatment had an effect on the flowering-period of the palm. From the 7th to the 10th years, significant differences exist only between new clearing and late thinning treatments, differences between other combinations of treatments being not significant. The presence of the old stand of palms in the late thinning treatment has retarded the growth of the second plantation considerably that only 55 per cent of the palms were in flower during the 9th year, whereas over 74 per cent have flowered in the other two treatments.

Bearing-age

The bearing status of palms has varied relative to the treatments as shown in Table 3, where a full-bearing palm is taken as one that has given a crop in the first harvest gathered at the beginning of the year or prior to that.

TABLE 3

Bearing status of palms

	Percentage of palms in		
	Full-bearing	Partial-bearing	Non-bearing
8th year after planting			
New clearing	32.4	17.3	50.3
Gradual thinning	13.8	17.8	68.4
Late thinning	8.0	8.6	83.3
9th year after planting			
New clearing	54.3	17.9	27.7
Gradual thinning	38.5	16.1	45.4
Late thinning	18.4	14.9	66.7
10th year after planting			
New clearing	75.1	9.8	15.0
Gradual thinning	56.3	12.1	31.6
Late thinning	35.6	6.9	57.5

The difference between treatments with respect to the number of full-bearing palms during the 3 years were significant (6th year $P = 0.01$ and 7th and 8th years $P = 0.05$), those with respect to partial-bearing palms were not significant. In the 8th year, new clearing treatment has given significantly more palms in full-bearing than the other two treatments, the differences between the latter being not significant; in the 9th year new clearing was superior to late thinning, the difference between gradual thinning and the other two treatments being not significant; in the 10th year new clearing and gradual thinning were superior to late thinning, the difference between the former two treatments being not significant.

Yield of nuts and copra

The palms started bearing in the 7th year after planting and the yield per acre has progressively increased from the 7th to 12th year (Table 4). There was a heavy incidence of yellowing of leaves due to magnesium deficiency in the 9th and 10th years in three of the blocks, and consequently the progressive increase in crop during the 10th year has been low relative to the increase in crop recorded in the 9th year.

TABLE 4

Yield per palm in full bearing and yield per acre

	Per palm in full-bearing		*Per acre*	
	Nuts	*Copra (lb.)*	*Nuts*	*Copra (cwt.)*
7th year after planting				
New clearing	—	—	337	1.91
Gradual thinning	—	—	146	0.64
Late thinning	—	—	42	0.24
8th year after planting				
New clearing	44	26.2	1,064	5.69
Gradual thinning	49	27.6	537	2.71
Late thinning	32	19.2	225	1.21
9th year after planting				
New clearing	46	25.6	1,720	8.42
Gradual thinning	47	24.3	1,244	5.76
Late thinning	43	23.9	594	2.96
10th year after planting				
New clearing	36	20.0	1,766	8.71
Gradual thinning	34	18.2	1,263	6.03
Late thinning	34	16.4	790	4.04
11th year after planting				
New clearing	45	27.3	2,389	12.94
Gradual thinning	45	26.9	2,014	10.57
Late thinning	48	30.3	1,584	8.65
12th year after planting				
New clearing	—	—	2,906	15.31
Gradual thinning	—	—	2,715	13.75
Late thinning	—	—	2,097	11.21

The yield per acre in the above table represents yield per acre of land and is not based on the yield per bearing palm multiplied by the appropriate number of palms per acre.

The analysis of variance of yield data after appropriate transformations show that the differences between treatments were significant ($P = 0.05$) as follows: 8th year—yield of nuts only, 9th and 10th years—yield of nuts and copra. Differences between treatments were not significant during the 11th and 12th years. When the critical differences were evaluated, the only significant factor was that palms in the new clearing treatment have given higher yields of nuts and copra than those in the late thinning treatment during the 8th, 9th and 10th years, except yield of copra in the 8th year. The differences in yield between new clearing and gradual thinning treatments, and the latter and late thinning treatments have not reached the required significant level.

DISCUSSION

In the evaluation of a suitable system of underplanting senile coconut plantations, one has to take into consideration the economic aspect wherein a reasonable income could be derived from the old palms without unduly retarding the growth of the young palms. From the results presented above, it is clear that the treatments could be placed in the following order of merit with respect to growth, bearing age and yield of the young palms: (*a*) New clearing, (*b*) Gradual thinning, (*c*) Late thinning.

The presence of the old stand of palms in the late thinning treatment has retarded the growth of the underplantation by over 50 per cent at the end of the 8th year, so much so, that only 44 per cent of the palms were in flower and 83 per cent were non-bearing, whereas in the new clearing treatments the comparative figures were 83 and 50 per cent respectively; even at the end of the 10th year 58 per cent of the palms were non-bearing. Therefore the late thinning system is not a satisfactory method of underplanting.

If the new clearing method is adopted, there is a total loss of crop from the old palms during the first seven years—14,000 nuts (approx.) per acre in this instance. The yield of young palms during the first few years of bearing has not been extraordinarily high to compensate for the loss in crop from the old palms (Table 5). Thus, the new clearing system of underplanting will not be suitable from an economic point of view.

The growth of palms in the gradual thinning treatment has been depressed relative to palms in the new clearing treatment (Tables 1 and 2), but the magnitude of the differences in yield of nuts (Table 4) is not so high during the 8th to 10th years, and thereafter the differences are fast evening out. Further, if the yield of the young palms and the remaining old palms are estimated, the gradual thinning method is at a distinct advantage over the new clearing (Table 5), having given nearly 6,000 nuts per acre more than the latter during the first 12 years.

TABLE 5

Total yield of nuts per acre that may be gathered during the first 12 years under the three different systems of underplanting

	From under-plantation	*From old planta-tion (estimated)*	*Total (approx.)*
New clearing	10,182	Nil	10,000
Gradual thinning	7,919	8,000	16,000
No thinning	5,332	14,000	19,000

The results of this experiment indicate that a system of gradual thinning of old coconut palms is a feasible method of underplanting senile plantations. In this instance 18 per cent of the old palms were removed during the first year and immediately before planting, and thereafter 10 per cent (approx.) each year, and the final lot being removed during the 8th year. Yearly removal of palms in this manner may not be necessary, provided that the old palms within 6 feet from new planting sites are removed prior to underplanting, which measures will reduce competition between young and old palms for nutrients and light, and the remaining palms are thinned out at two to three year intervals.

SUMMARY

The results of three methods of underplanting senile coconut plantations are presented. The late thinning system is not suitable as the bearing age of the young palms is unduly delayed due to the presence of the old stand of palms. The new clearing system is not desirable from an economic point of view due to the total loss of crop from the old palms. The gradual thinning system appears to be a feasible method of underplanting.

ACKNOWLEDGEMENTS

My thanks are due to Mr. V. Abeywardene, Biometrician for statistical analysis of data.