

TODDY YIELDS FROM HYBRID COCONUT PALMS

M. JEGANATHAN

Coconut Research Institute, Lunuwila, Sri Lanka

SUMMARY

Yield records were maintained on twelve Typica × Pumila (F₁) hybrid coconut palms for a 12 month period. The records show that these hybrids can effectively substitute the *typica* variety for the treacle jaggery and fermentation industries.

INTRODUCTION

In Sri Lanka almost the entire 1.15 million acres under coconut are planted with the tall variety classified botanically as variety-typica, form-typica. Of the varieties and forms grown locally, this has been found to be the most suitable for commercial exploitation (Liyanage 1958). From the standpoint of the yield of sap (toddy) which constitutes the bedrock of the fermentation industry, so far only the tall variety has been exploited. Nathanael (1951 and 1955) has found the dwarf variety (Nana) unsuitable for tapping purposes. Though it has the advantage of easy reach, facilitating tapping operations, this is offset by its low toddy yields (52% to 53% of the tall palm yield) and its susceptibility to drought and attack by pests.

With the initiation of hybridization work at the Coconut Research Institute in 1949, crosses between selected varieties and forms were made, and it was found that the *typica* × *nana* (pumila) cross was the most promising, bearing nuts of good size and out yielding the *typica* variety (Liyanage 1955). Based on these findings the *typica* × *nana* (F₁) hybrid is being supplied to the industry as suitable for planting in the wet zone. It is also envisaged that in future replanting schemes the existing stands will be replaced in all suitable areas by these hybrids. In this context, it has been deemed useful to examine the toddy yield potentialities of these hybrids in order to ascertain whether or not they should prove effective substitutes as a source of toddy for the treacle, jaggery and fermentation industries.

Apart from the expertness of the tapper, toddy yields could be influenced by genetical, physiological and ecological factors. Consequent on an interplay of these factors, diurnal and seasonal fluctuations could be observed not only between palms but also between spadices on the same palm.

Locality and selection of palms

Based on pre-determined characteristics reckoned to be suitable for tapping purposes, twelve healthy hybrid palms (*Typica* × *Pumila*) were selected from the Botanist's Field No. 6 at Bandirippuwa Estate, Lunuwila. The palms (averaging 13 years) were selected from the same soil type, and were subjected to uniform fertilizer treatment and cultural practices.

Tapping procedure

The technique of tapping employed for this study is that evolved from the traditional method, with appropriate modifications (Nathanael 1966). The spathes were pared twice a day, morning and evening, and toddy yield measurements made every morning at the end of each 24 hour period.

Records and observations

Tapping was commenced on 20th April 1973 and the yield records maintained were for 14 months from 1973 to June 1974.

Table I gives the yield records averaged out at 10-day intervals for a period of one year. The figures show yield variations between palms and wide fluctuations within individual palms, at different periods.

Fig. I shows the toddy yields per day, averaged at 10 days intervals. Both diurnal and seasonal fluctuations are evident and from June 1973 to March 1974, the yield of toddy fluctuated between 1,800 ml. to 2,400 ml. Despite tapping for a continuous period of 14 months, the palms showed no ill-effects. Table II (A) gives the overall daily yield per palm for the 12 month tapping period as 2,177 ml. (0.48 gallon/day/palm). On the basis of 64 palms to the acre, the daily yield of toddy would be 30.6 gallons, compared to 22.3 gallons from the typical variety and 6.7 gallons from the dwarf variety (at 100 palms to the acre), (Nathanael 1965).

Table II (B) and the histogram Fig. II, show the overall daily yield for different tapping periods, ranging from one month to an year. It is clear from the results, that in the hybrids, the daily average increases upto the 5th month and then remains fairly steady with a yield of over 2,100 ml. upto the 12th month of tapping. Probably it would be safe to assume that for maximum economic exploitation the hybrids could be tapped for a continuous period of one year without damage to their health.

Table II (C) shows the monthly recoveries of sap in relation to the total annual yields. It would be observed that the sap flow is fairly evenly distributed throughout the year, with monthly recoveries ranging from between 4.5% to 10.2% of the annual yields. During the first eight months the sap recovered is 65.2% and in the first ten months 80.5% of the total annual yield.

Yield in terms of spadices

The observation has been made that it takes about 12-14 days from the time of preparation of the spadix for the flow of sap to begin.

The toddy yield data for the hybrids in terms of spadices tapped are given in Table III and illustrated in Fig. III. It will be observed that there are considerable variations in the yield of sap from spadices of the same palm and between palms. Besides, the duration of sap flow, varied from spadix to spadix, the overall average being 20.6 days for the average of 17.7 spathes tapped during a 365 day period. The yield of sap per spadix averaged 44,849 ml. (9.9 gals.) with a wide range of variation, lying between 21,760 ml. to 53,186 ml. (4.8-11.7 gallons). The coefficient of variability of yield per spadix is 18.9.

| <i>Number of Spathes</i> | <i>Average Yield of Sap/ Spathe (ml.)</i> |
|------------------------------------------------------------------------|-----------------------------------------------|
| 1 | 47,870 |
| 2 | 38,186 |
| 3 | 53,186 |
| 4 | 48,468 |
| 5 | 49,105 |
| 6 | 49,861 |
| 7 | 46,529 |
| 8 | 47,436 |
| 9 | 47,090 |
| 10 | 46,545 |
| 11 | 46,835 |
| 12 | 51,653 |
| 13 | 38,565 |
| 14 | 47,975 |
| 15 | 50,663 |
| 16 | 46,952 |
| 17 | 29,552 |
| 18 | 32,034 |
| 19 | 21,760 |
| Total yield for 365 days (ml) weighted average | 794,741 |
| Mean production/spathe for all spathes tapped (ml) weighted average | 44,849 |
| Range of production | 21,760 - 53,186 |
| Co-efficient of variation | 18.91 |
| Standard Deviation | +8.361 |
| Average duration of tapping period/spathe (days) | 20.6 |

DISCUSSION

It would be appropriate to consider the morphological and genetical characteristics of the *typica* (tall) and *nana* (dwarf) varieties and the salient characters of the hybrids obtained by crossing them. The *typica* is tall in habit, late flowering, cross fertilized, having nuts of medium size with a copra content of 0.5 lb./nut; the *nana* (dwarf) on the other hand is short in habit, early flowering, is self fertilized, having nuts of small size with a copra content of 0.2 lb./nut. The first generation crosses of these resulted in a promising vigorous strain, flowering early and bearing nuts of good size. The other important character being the greater production of leaves, averaging four more than the *typica* palms. This leads to a greater number of inflorescences, because each leaf axil produces an inflorescence. It has also been noted that the hybrids produce appreciably longer leaves and leaflets with sturdier trunks (Liyanage 1955 and Manthirathne 1971). These vegetative characters may be reckoned to be desirable attributes of palms that are to be tapped.

Nathanael (1955) concluded that in Sri Lanka, the *nana* (dwarf) variety is uneconomical for tapping whilst the yield potentialities of the *typica* make it eminently suitable for this purpose. It will be seen that the average daily yield and the total yield per palm, for a 365 day tapping period for the *typica* variety are 1,582 ml. and 577.5 litres respectively. The corresponding figures for the hybrid are 2,177 ml. and 791.7 litres. On the other hand, a spadix from a

typica gave an average yield of 49.5 litres during 31.2 days as against 44.8 litres and 20.6 days respectively for a hybrid spadix. The fact that more number of spadices are tapped in the hybrids, (17.7) in comparison with the *typica* (11.7). (Nathanael 1955) explains how the hybrids outyield *typica* in the flow of sap. As indicated earlier, the greater number of spadices tapped in the hybrids over the *typica* is consequent on the greater number of fronds produced per year.

CONCLUSIONS

Though the yield records for the *typica*, *nana* and the (*typica* × *Pumila*) hybrids were studied under different environmental conditions and times, there is no doubt that, for the fermentation industry, the *typica* × *Pumila* (F_1) hybrid could adequately replace the *typica* variety, under climatic and edaphic conditions suitable for their cultivation. A set of palms could safely and economically be tapped for a continuous period of one year, although approximately 80 per cent. of the total yield could be recovered by the end of the 10th month. Possibly different sets of hybrid palms, could be tapped on a rotational basis for a continuous period of 12 months. If, however, the same set of hybrid palms are to be used, then, it would be advisable to terminate tapping at the end of the 10th month and recommence tapping after a rest period of four months, a practice adopted for *typica* palms. This is being made as a tentative recommendation as the present study has had its limitations.

Fresh toddy from the *typica* palms has an average sucrose content of 15% (Nathanael 1962) and a similar average has been reported for the hybrids that have been studied (Mohanadas 1972). There is no reason to doubt that these hybrids can satisfactorily replace the *typica*, for the fermentation, treacle and jaggery industries.

The author wishes to record his grateful thanks to Messrs J. E. Premaratne and M. A. Perera for the careful tapping of the hybrid palms selected for this study, and to the staff of the Chemistry Division who extended their co-operation in maintaining the field records.

FIG-I

TODDY YIELD AVERAGES PER DAY FOR
TEN-DAY PERIODS

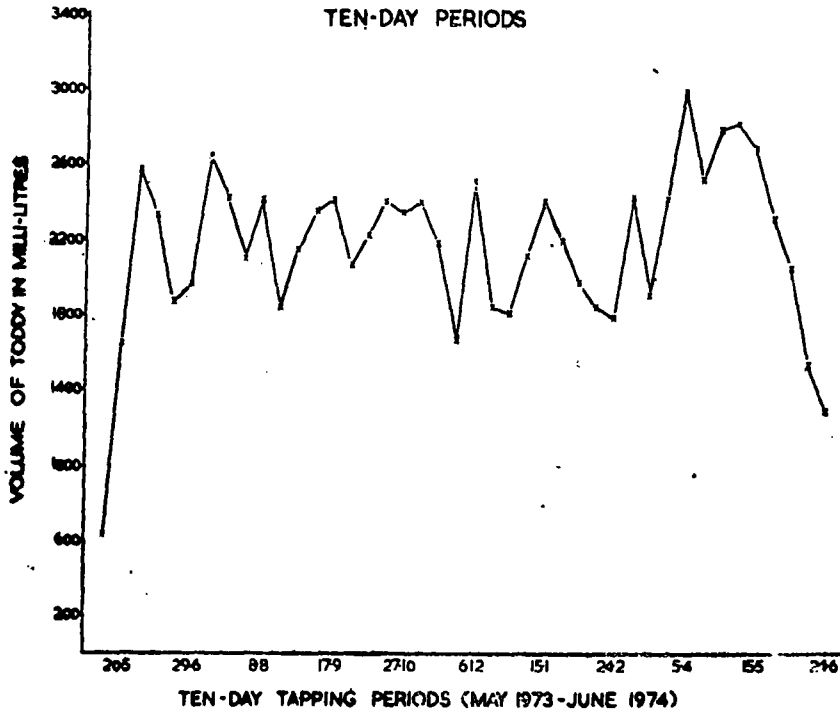
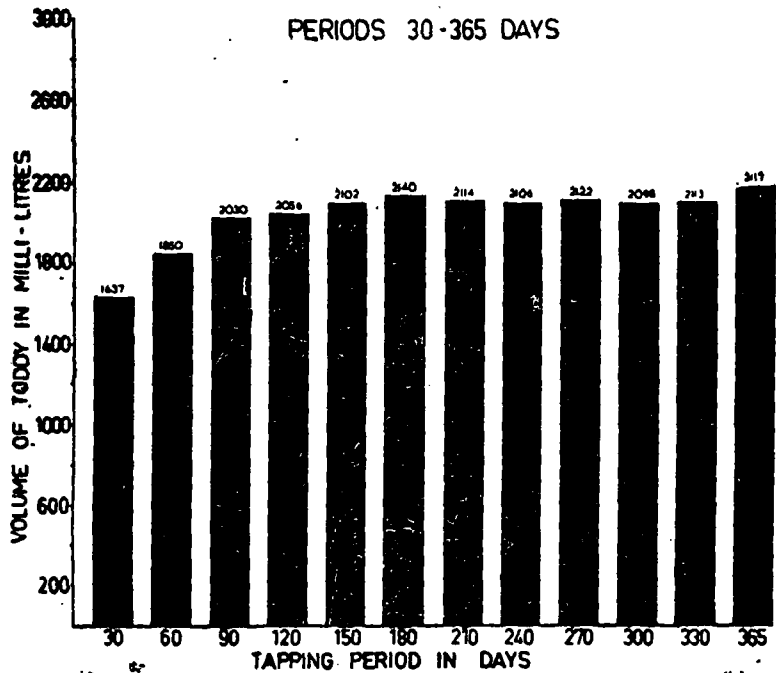


FIG-II

OVERALL DAILY YIELD OF TODDY FOR TAPPING
PERIODS 30-365 DAYS



TODDY YIELDS FROM HYBRID COCONUT PALMS

FIG - III

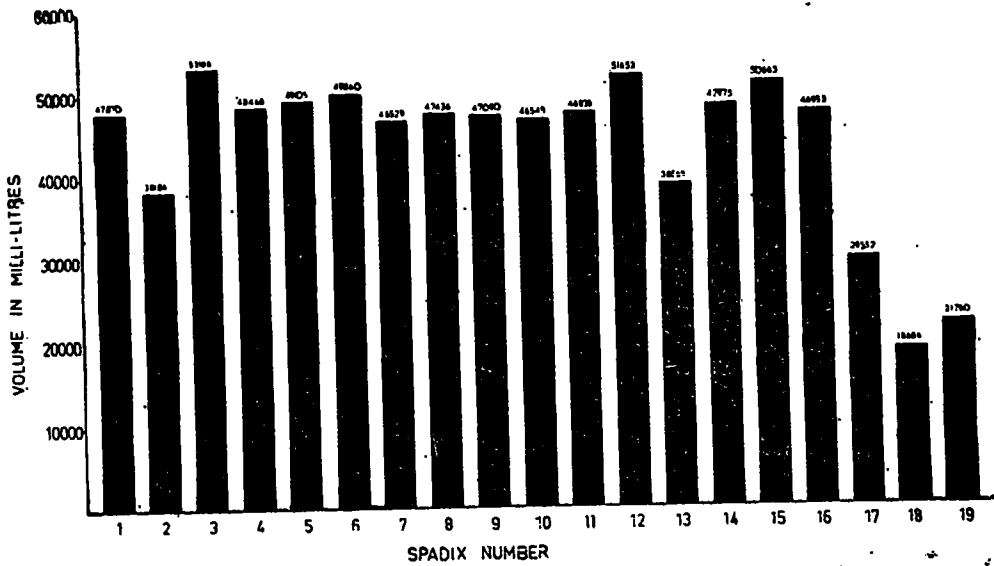
TODDY YIELD IN TERMS OF SPADICES
(AVERAGE OF 12 PALMS)

TABLE I

Yields of Toddy (in Millilitres)

(Records kept during the period May 1973 to April 1974 on *Typica* × *Pumila*—Hybrids at Bandrippuwa Estate, Lunuwila)

| <i>*Monthly Averages</i> | <i>Palm A</i> | <i>Palm B</i> | <i>Palm C</i> | <i>Palm I</i> | <i>Palm E</i> | <i>Palm F</i> | <i>Palm G</i> | <i>Palm H</i> | <i>Palm I</i> | <i>Palm J</i> | <i>Palm K</i> | <i>Palm L</i> | <i>Average daily yield per palm</i> |
|----------------------------------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------------------------------|
| May .. | 18906 | 13820 | 19606 | 19950 | 11933 | 11310 | 16376 | 16663 | 16836 | 10776 | 22900 | 17616 | 1637 |
| June .. | 14858 | 19825 | 21363 | 20920 | 18030 | 16198 | 28046 | 25720 | 18463 | 21667 | 21323 | 21143 | 2063 |
| July .. | 24453 | 18167 | 25523 | 18513 | 33780 | 21380 | 24457 | 25063 | 27040 | 22787 | 22600 | 23183 | 2391 |
| August .. | 25040 | 25247 | 20853 | 19327 | 13200 | 15753 | 24667 | 19333 | 25163 | 23820 | 22780 | 20820 | 2132 |
| September .. | 28447 | 17977 | 16227 | 21233 | 16693 | 19363 | 29422 | 27600 | 24103 | 27357 | 24080 | 21433 | 2283 |
| October .. | 27310 | 21560 | 23473 | 20750 | 22713 | 19907 | 28780 | 24577 | 21710 | 25630 | 18183 | 25157 | 2331 |
| November .. | 18927 | 10112 | 13883 | 21077 | 21867 | 19550 | 26863 | 18937 | 23100 | 23120 | 18930 | 18350 | 1956 |
| December .. | 23310 | 15160 | 22907 | 18427 | 20113 | 17883 | 26797 | 15050 | 21633 | 17580 | 22947 | 24972 | 2057 |
| January .. | 23587 | 16113 | 25230 | 19070 | 23353 | 25530 | 23943 | 26200 | 23947 | 21283 | 19900 | 21647 | 2248 |
| February .. | 22612 | 15193 | 17657 | 19700 | 18453 | 25963 | 19360 | 17522 | 5347 | 19343 | 18490 | 25673 | 1878 |
| March .. | 23753 | 16513 | 22507 | 21260 | 30127 | 28377 | 19938 | 27110 | 18200 | 22180 | 21927 | 20513 | 2270 |
| April .. | 33083 | 21149 | 31097 | 21054 | 30802 | 36320 | 28060 | 26729 | 28017 | 23556 | 25614 | 27137 | 2780 |
| Average daily yield per palm 8 months (May-December) 240 days. | 2266 | 1771 | 2048 | 2003 | 1979 | 1767 | 2568 | 2162 | 2226 | 2159 | 2172 | 2159 | 2106 |
| Average daily yield per palm 12 months (May-April) 265 days. | 2382 | 1760 | 2182 | 2012 | 2198 | 2166 | 2477 | 2260 | 2122 | 2162 | 2169 | 2237 | 2177 |

*Each month represents the average of three—ten day periods.

TABLE II
Toddy Yield Statistics on Typica × Nana Hybrids
 (Records kept during the period May 1973 to April 1974 at Bandirippuwa Estate, Lunuwila)

(A) Summary of overall average yields

| 1 Overall total yield/palm (ml) | | | 2 Overall total daily yield/palm (ml) | | |
|------------------------------------|------------------------|-------------------------|------------------------------------------|------------------------|-------------------------|
| 6 months (180 days) | 8 months (240 days) | 12 months (365 days) | 6 months (180 days) | 8 months (240 days) | 12 months (365 days) |
| 385,180 | 505,554 | 794,741 | 2140 | 2106 | 2177 |

(B) Summary of overall daily yields

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------|
| 1st 30 days | 1st 60 days | 1st 90 days | 1st 120 days | 1st 150 days | 1st 180 days | 1st 210 days | 1st 240 days | 1st 270 days | 1st 300 days | 1st 330 days | 1st 365 days |
| (1 month) (ml) | (2 months) (ml) | (3 months) (ml) | (4 months) (ml) | (5 months) (ml) | (6 months) (ml) | (7 months) (ml) | (8 months) (ml) | (9 months) (ml) | (10 months) (ml) | (11 months) (ml) | (1 year) (ml) |
| 1637 | 1831 | 2031 | 2056 | 2102 | 2140 | 2114 | 2106 | 2122 | 2098 | 2113 | 2177 |

(c) Summary of overall monthly yield as % of total annual yield

| 1 Month | 2 Monthly yield ml. | 3 as % of total yield (12 months) | 4 Yield since 1st May as % of total yield (12 months) |
|--------------|---------------------------|-----------------------------------------|----------------------------------------------------------------|
| May 1973 | 51376 | 6.5 | 6.5 |
| June | 61158 | 7.7 | 14.2 |
| July | 73833 | 9.3 | 23.5 |
| August | 66832 | 8.4 | 31.9 |
| September | 68239 | 8.6 | 40.5 |
| October | 73388 | 9.2 | 49.7 |
| November | 59855 | 7.5 | 57.2 |
| December | 63343 | 8.0 | 65.2 |
| January 1974 | 68146 | 8.6 | 73.8 |
| February | 53591 | 6.7 | 80.5 |
| March | 74215 | 9.3 | 89.8 |
| April | 80765 | 10.2 | 100.0 |
| Total | 794741 | 100.00 | |

TABLE III

Variation in the Production of Toddy per Spadix (Volume on milli-litres)

Records kept during the period May 1973 to April 1974 on Typica x Nana Hybrids (A to L) at Bandirippuwa Estate, Lunuwila

| I | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------------------------------------------|
| Spadix No. | Palm A | Palm B | Palm C | Palm D | Palm E | Palm F | Palm G | Palm H | Palm I | Palm J | Palm K | Palm L | Average yield per spadix for 12 palms |
| 1 | 66380 | 42420 | 41380 | 35400 | 51770 | 3010 | 39200 | 44250 | 53695 | 45150 | 60870 | 46050 | 47870 |
| 2 | 10155 | 32035 | 50090 | 37460 | 28430 | 36470 | 59030 | 46830 | 40530 | 41590 | 42680 | 32930 | 38186 |
| 3 | 46410 | 51860 | 50140 | 45990 | 60700 | 29365 | 74850 | 69980 | 53720 | 46910 | 52650 | 55660 | 53186 |
| 4 | 46050 | 55920 | 51290 | 37260 | 70140 | 35370 | 50600 | 35580 | 58780 | 49540 | 44490 | 46590 | 48468 |
| 5 | 47350 | 66030 | 54910 | 40600 | 8180 | 44970 | 57510 | 42730 | 70560 | 58960 | 29360 | 27180 | 49105 |
| 6 | 63000 | 31850 | 19640 | 66900 | 36970 | 34950 | 62280 | 54090 | 45680 | 47130 | 69280 | 66560 | 49861 |
| 7 | 61440 | 45840 | 53540 | 41120 | 40030 | 35960 | 51180 | 46170 | 49310 | 60280 | 45840 | 27640 | 46529 |
| 8 | 41030 | 53945 | 38320 | 34550 | 48540 | 33740 | 77380 | 54620 | 42960 | 52050 | 32520 | 59580 | 47436 |
| 9 | 59620 | — | 44210 | 40770 | 45260 | 38560 | 60400 | 41460 | 65140 | 38840 | 31500 | 52240 | 47090 |
| 10 | 33020 | 57360 | 46700 | 38780 | 57720 | 47810 | 55620 | 42270 | 40040 | 46000 | 53600 | 39620 | 46545 |
| 11 | 55770 | 37860 | 52734 | 35260 | 33760 | 44830 | 55850 | 39390 | 63120 | 38400 | 43840 | 58200 | 46835 |
| 12 | 59680 | 39840 | 54750 | 56840 | 77440 | 30730 | 68170 | 57040 | 36940 | 55960 | 30560 | 45880 | 51653 |
| 13 | 46840 | 39980 | 32190 | 27430 | 22120 | 60850 | 34560 | 34370 | 2920 | 37700 | 42920 | 45250 | 38565 |
| 14 | 45220 | 39400 | 62980 | 20350 | 107180 | 44100 | 31880 | 44510 | 38940 | 38220 | 40550 | 62370 | 47975 |
| 15 | 59400 | 16340 | 43880 | 43760 | 64280 | 70710 | 63850 | 51040 | 57020 | 51760 | 47740 | 38280 | 50663 |
| 16 | 49450 | 30715 | 62960 | 37280 | 43930 | 41200 | 47170 | 44720 | 46610 | 49700 | 41920 | 67780 | 46952 |
| 17 | 40810 | 2770 | 31700 | 37600 | 5980 | 58590 | 13100 | 49260 | 11090 | 27240 | 45740 | 30730 | 29552 |
| 18 | 38090 | — | — | 32730 | — | 76860 | — | 28210 | — | 5045 | 31290 | 12010 | 32034 |
| 19 | — | — | — | 15520 | — | 28000 | — | — | — | — | — | — | 21760 |
| Total for 365 days (ml) | 869715 | 644165 | 791410 | 725600 | 802430 | 796075 | 905639 | 826520 | 777055 | 790475 | 793350 | 814450 | Average of total for 365 days 794741 (12 palms) |
| Aver. volume for spathe (ml) excluding first and last spathes tapped | 47828 | 42784 | 47889 | 39687 | 49645 | 45003 | 56899 | 47129 | 47485 | 46268 | 43824 | 47274 | 46810 |
| Aver. volume for spathe (ml) all spathes tapped | 48318 | 38792 | 46554 | 38189 | 47202 | 41899 | 53273 | 45918 | 45709 | 43915 | 44075 | 45247 | 44849 |
| | $\frac{794.741}{44.849} = 17.7 \text{ spathes per 365 days.}$ $\text{i.e. 1 spathe was tapped for 20.6 days (approx.)}$ | | | | | | | | | | | | |

REFERENCES

- Liyanage, D. V. 1958. *Ceylon Cocon. Q.* 9:1.
Liyanage, D. V. 1955. *Rep. Cocon. Res. Inst. Ceylon* for 1955, 41.
Mohanadas, S. 1972. Personal communication.
Manthirratna, M. A. P. 1971. *Ceylon Cocon. Q.* 22:107.
Nathanael, W. R. N. 1951. *Rep. Cocon. Res. Inst. Ceylon* for 1951, 15.
Nathanael, W. R. N. 1955. *Ceylon Cocon. Q.* 6:8.
Nathanael, W. R. N. 1966. *Ceylon Cocon. Phys. Rev.* IV (4):87.
Nathanael, W. R. N. 1960. *Ceylon Cocon. Q.* 11:31.