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Tapping Patterns in the Nipa Palm (Nypa fruticans Wurmb.)

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Today the nipa palm is found in the eastern tropics stretching from Southeast Asia through Borneo, Irian Jaya and Papua New Guinea to North Australia (Tralau 1964). It forms pure stands with a closed canopy and is found in mixed vegetation with other mangrove species in estuary lowlands which are subject to frequent flooding by brackish tidal waters (Paijmans 1976, Fig. 1A). Nipa differs from other palm species in that it lacks a distinct erect stem (Fig. 1B). It has a stout dichotomously branching rhizome which gives rise to the upright fronds and the flower stalks. The length of fronds is from 3 to 13 meters depending on the locality (Dugros 1933, Amio et al. 1979, Päivöke et al. 1982). Throughout the eastern tropics the fronds of the nipa palm are used for the construction and thatching of village houses (Fig. 1A). From the young leaflets and midribs mats, baskets, sunhats and brooms can be manufactured. The base of the central apical bud is eaten as "cabbage."

Under natural conditions 30% of nipa palms produce flowers and one flowering palm produces 1–2 stalks yearly (Amio et al. 1979). In Papua New Guinea the average weight of a mature infructescence is about 15 kg, ranging from 6 to 30 kg (Päivöke 1984). It comprises tightly wedged 1-seeded nuts (Fig. 1C). The seeds of the nuts are edible when young (Tralau 1964, Percival and Womersley 1975). The length of the flower stalks, which are sources of sweet sap, is reported to vary from about 0.6 to 2.2 meters (Amio et al. 1979, Päivöke 1984, Fig. 2A–D).

Nipa Sap

The sap of the nipa palm has been used as a source of an alcoholic beverage in Far-East Asia since the earliest times. Sugar or syrup and vinegar can also be manufactured from the sap.

The estimated yields of sap from the nipa palm vary from one source to another. Gibbs (1911) states that about 1.25 liters/palm/day can be extracted. Thus an average plant will yield about 50 liters of sap/tapping season equalling about 440 liters of sap/ha/day and about 78,500 liters/ha annually. A more recent estimate from the Philippines is about 126,000 liters of sap/ha/year (Amio et al. 1979). In Papua New Guinea investigations have revealed that about 169,000 liters of sap may be produced annually per hectare of the nipa palm (Päivöke 1984).

The sugar content of the fresh nipa sap is known to be an average of 14–17% w/v depending on the locality (e.g., Pratt et al. 1913, Päivöke 1984). Therefore, an alcohol content of about 6–7% w/v may be taken as the average for the fully fermented nipa sap (e.g., Päivöke 1984).

In the early decades of the 20th century palm saps were major sources of alcohol in the Philippines: in 1910 about 93% of the total amount of alcohol and

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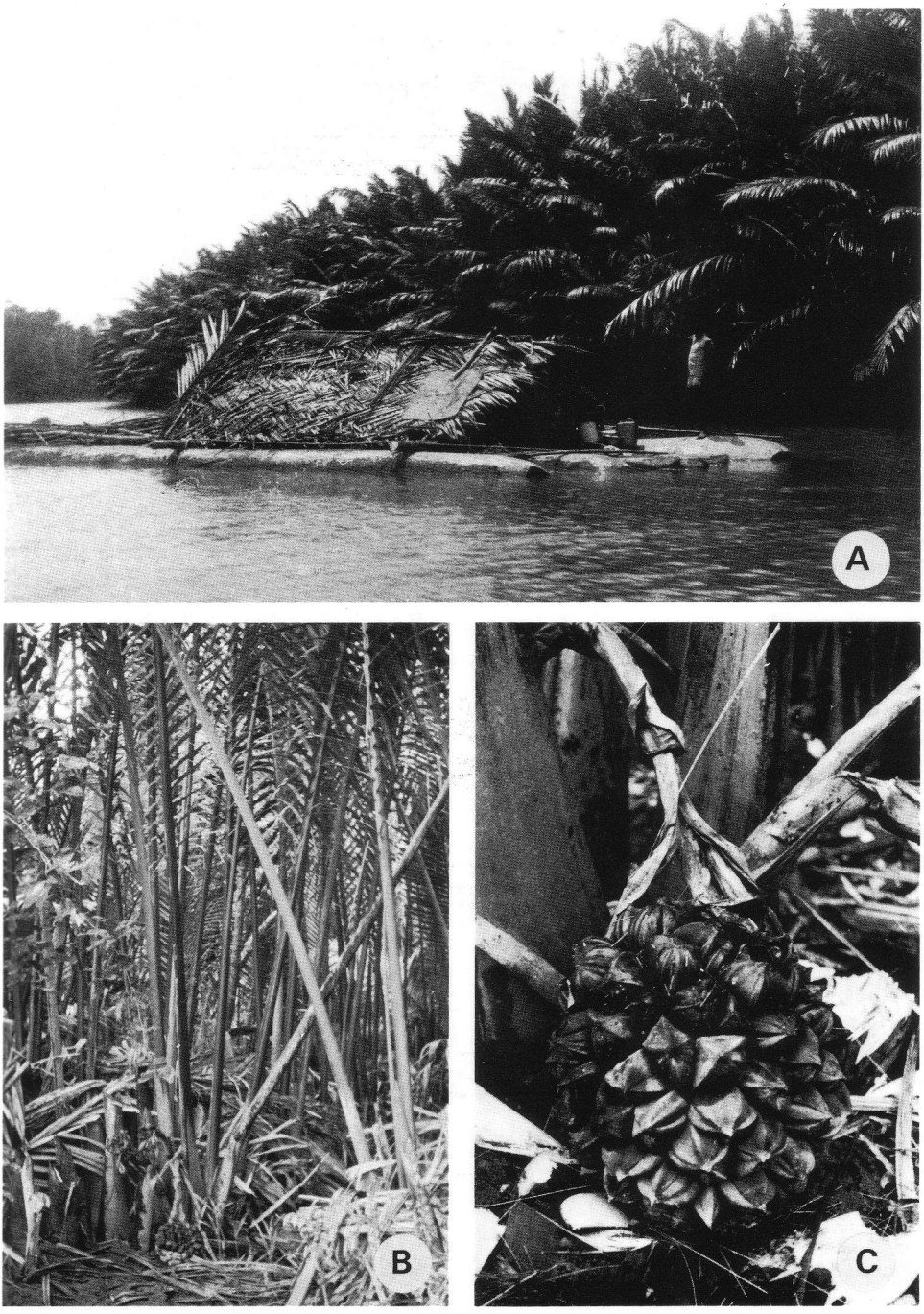

1. A. A thick wall of nipa bordering a river in Baimuru district of the Gulf Province in Papua New Guinea. Nipa is also used as a construction material: a temporary nipa-hut on floating logs. B. A close view into a nipa thicket. C. The infructescence of the nipa palm comprises 1-seeded, tightly packed nuts.

alcoholic beverages were distilled from palm saps. But due to changed conditions and the increasing availability of molasses the utilization of palm extracts declined and in 1920 only about 35% of the alcohol in the Philippines was produced from this source (Cole 1922). However, research into the potential of the nipa palm as a source especially of sugar continued. It was noticed that under conditions of cultivation the percentage of flowering of the nipa palm is higher than in its natural state. Furthermore, in plantations the nipa was reported to produce up to 16 stalks per plant (Hofstede 1929). Ambitious plans for utilizing the nipa palm as a source of fuel alcohol and sugar were based on the assumption that all the stalks produced by one plant may be tapped simultaneously. Dennett (1927) mentions tapping of two stalks per plant, and Hofstede (1929) four. Today in the Philippines the tappers warn against tapping more than one stalk of the entire nipa palm colony; otherwise the plants may die. Tapping of all the stalks of each palm is carried out in Borneo today, although the sap yields are apparently smaller than the average for the nipa palm (Päivöke et al. 1982).

Obvious disagreement exists in the literature regarding the tapping of several stalks per plant or all the stalks of the nipa colony, i.e., the tapping of all the plants produced vegetatively by the dichotomous branching of the rhizome. Because of this, some investigation was made into this matter in conjunction with a 3-year feasibility study conducted at Baimuru in the central area of the Gulf Province of Papua New Guinea by the Department of Minerals and Energy (Newcombe et al. 1980).

Tapping Yields in Papua New Guinea

Tapping of the nipa was performed during 1980–1983 in seven villages of Baimuru district located 1.5–23 km from the sea. The average yield of sap/palm in the district was found to vary from 0.6 to 1.8 liters/palm/day.

Tapping of Two Stalks Per Plant

The tapping site of Lavipaka included two adjacent plots of about 30 × 30 m each. They were located about 12–15 km from the sea on a side creek of Pie River.

Palm number 235 in the Lavipaka village area had two stalks, which were treated and eventually tapped simultaneously. One stalk was tapped for only one month after which it dried, and the second stalk yielded sap for 2.5 months, after which it too dried. During the first month, when both stalks were tapped simultaneously, stalk number one gave an average of 711 ± 140 ml/24 hours, and number two an average of 706 ± 89 ml/24 hours, totalling 1,417 ± 229 ml/24 hours for the whole plant. Consequently during this month about 43 liters of sap were collected from the whole plant. Stalk number two was tapped for an additional one and a half months. During this time the stalk yielded 548 ± 92 ml/24 hours of sap. Calculated as the total yield of sap per plant in the 2.5 month tapping period, the whole plant produced about 70 liters. The average tapping period in Lavipaka area, when only one stalk per plant was tapped, was 3–4 months; i.e., stalks yielded sap until they had to be abandoned as they were too short for shaving (Fig. 2C). The average sap yield in the two seasons in Lavipaka, when only one stalk per plant was tapped, was 1,200 ± 79 ml/24 hours and if the minimum tapping season is taken as 3 months the average sap production per plant in this area totals about 108 liters. Therefore, tapping two stalks in this example decreased the average sap yield per season by about 35% and slightly shortened the tapping period.

2. A. The flower stalks of the nipa palm in Baimuru district may attain a considerable length. The stalk is covered by numerous spathes. B. The spathes are removed at first when stalks are worked for sap extraction. C. After the required pretreatment of the stalks the infructescence is cut off. Thereafter, the stalk must be shaved twice a day to ensure sap flow. D. Bamboo joints of single or double internode lengths are used for sap collection. The end of a stalk is inserted in the bamboo through the hole.

Table 1. Tapping of members of the same nipa colony. Comparison of yields.[a]

1st month of tapping	palm 201 (daughter)		palm 203 (mother plant)		palm 202 (daughter)	
	am (ml)	pm (ml)	am (ml)	pm (ml)	am (ml)	pm (ml)
	579 ± 78	191 ± 19	348 ± 61	123 ± 11	1,125 ± 132	244 ± 25
	770 ± 97 ml/24 h		471 ± 72 ml/24 h		1,369 ± 157 ml/24 h	
	Total yield per 3-palm colony: 2,610 ± 326 ml/24 h					
2nd and 3rd months of tapping	am (ml)	pm (ml)			am (ml)	pm (ml)
	1,454 ± 116	282 ± 18	—	—	1,633 ± 113	351 ± 21
	1,736 ± 134 ml/24 h		—		1,984 ± 134 ml/24 h	
	Total yield per 3-palm colony: 3,720 ± 268 ml/24 h					
Increase in flow after the 1st month; only two members tapped of 3-palm colony	am	pm			am	pm
	60%	32%			31%	30%
	Total flow: 42.5%					

[a] Standard errors indicated. Abbreviations: am (ml) = ml of sap collected during the night (about 17 hours), pm (ml) = ml of sap collected during the day (about 7 hours).

Similar cases were also recorded in other sites where tapping was carried out.

Tapping of Members of the Nipa Colony

The vegetative propagation of the nipa palm is known to start about one year after germination and thereafter the rhizome branches dichotomously about every second year (Pratt et al. 1913, Tomlinson 1971). At about 10 years of age the nipa palm fronds attain their full length and the rhizome reaches a stable state of continuous growth, i.e., division at one end and decay at the other. As a consequence, older nipa palms grow in colonies of several plants. In the course of a 3-year study conducted in the Gulf Province of Papua New Guinea, it was repeatedly observed that palms which apparently grew in short colonies with only one stalk tapped produced higher yields than several palms of a long colony tapped simultaneously. The example of palms number 201, 202 and 203 offer an illustration of this.

In Lavipaka tapping site, palms number 201, 202 and 203 formed a cluster so that 203 represented the point of dichotomous branching; i.e., the mother plant, and 201 and 202 were daughter plants. The palms were about one meter from each other in a triangle-like formation. During the first month of tapping, plant number 202 gave the highest yield, about 1,370 ml/24 hours, number 203 the lowest, about 470 ml/24 hours, and palm number 201 yielded about 770 ml/24 hours of sap (Table 1). The average yield per palm in the 3-palm colony was then about 870 ml/24 hours, which is about 27% lower than the average in this area, which was about 1,200 ml/24 hours. After the first month of tapping, palm number 203 (the mother plant) ceased to flow and dried up, after which there was an increase of about 60% in the night-flow and about 32% in the day-flow in plant number 201, and about 30% increase in the day- and night-flows of palm number 202. The average yield per plant now becomes about 1,860 ml/24 hours

and the total yield of the 3-palm colony was now about 3,720 ml/24 hours. This may be compared with an average of 2,610 ml/24 hours during the first month of tapping, an increase of about 42.4% in the total flow, when only the daughter plants were tapped (Table 1).

In the Lavipaka tapping site the average sugar content of the sap varied from about 13 to about 18% w/v depending on the season, length of the stalk, yield, etc. It was noticed that the sugar content was slightly lower than the average of 16.4% w/v in the district (Päivöke 1984) if the yield of sap was very high. However, the decrease was not significant.

The nipa palm is known to be capable of producing sap 5–6 years after germination and is productive for approximately another 45 years (Anon. 1922). In view of the examples presented here, one explanation of the poor yields in old nipa palm groves (Pratt et al. 1913) may be the tapping of members of one colony which are too close together. Further investigations into the "family relationships" of the nipa palm are needed in order to optimize the sap yields.

Conclusions

In the course of a 3-year study conducted in the Gulf Province of Papua New Guinea it became clear that if two stalks per palm were treated and tapped simultaneously it may decrease the total yield per plant and also shorten the tapping period. Furthermore, the study supports the view that selective tapping of only some members of one entire nipa colony may increase the total sap yield. As the nipa palm resources today are receiving increasing interest in Far-East Asia and South Pacific countries as a potential source of alternative energy, as well as of sugar or syrup, the observations presented here may be of interest in maximizing the daily sap yields per plant, as well as in stimulating further research into the optimum mode of tapping this palm species.

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