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THE SEX RATIO OF *CALAMUS SUBINERMIS* PLANTED IN A SECONDARY FOREST AND *ACACIA* PLANTATION

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Calamus species have been documented to be dioecious (Uhl & Dransfield 1987). However, the phenomenon of andromonoecy, i.e. the occurrence of separate male and hermaphroditic flowers on the same individual, has been observed in *Calamus subinermis* planted in a secondary forest (Lee 1995).

The sex of rattan is determined by the structure of the inflorescence, whether they are staminate or pistillate. It can be determined only after the first flowering of the plant. The sex ratio of *C. manan* is reported to be 1.55:1, male to female (Aminuddin & Nur Supardi 1993) and that of *Salacca* species is 9:1 (Nur Mahadi 1989); in *C. filipendulus* four out of four planted plants were male (Manokaran 1985). Basically, these results indicate that there are more male than female rattans in a population. In this regard, natural pollination will be difficult due to less occurrence of female rattans. Hence, the occurrence of andromonoecy in *C. subinermis* might give a good implication for artificial pollination.

A survey was carried out separately in the 5-year-old provenance *cum* progeny trial of *C. subinermis* at Kolapis A (a secondary logged-over forest) and Segaliud Lokan (7-year-old *Acacia* plantation). The planting distances are 2 × 3 m and 2 × 5 m in Kolapis A and Segaliud Lokan respectively. The soil in Kolapis A is loam and clayey loam of Tanjung Lipat Family whilst in Segaliud Lokan the soil is sandy loam to sandy clayey loam (Acres & Folland 1975). The terrain ranges from gently undulating in Kolapis A to steep in Segaliud Lokan. The annual rainfall of these areas is about 3000 mm (Nilus 1996).

The observation was carried out during the flowering season. The first flowering of *C. subinermis* in these trials was observed after 2 1/2 years of planting (most of the seedlings planted had been kept in the nursery for one year or more). Lee (1995) reported that the flowering season for *C. subinermis* is the whole year round. Hence, observation was carried out during the plot measurement. Parameters recorded were flowering behaviour and sex of the rattan.

The result obtained indicates that there are more female than male and hermaphrodite plants in the *C. subinermis* population. A total of 3525 plants and 4075 plants were observed in Kolapis A and Segaliud Lokan respectively. During the survey, most of the plants were not flowering. Flowering occurred in 774 plants at Kolapis A and in 434 plants at Segaliud Lokan. The inflorescences of some plants were shed and others were still at the initial stage of bearing flowers and hence their sex could not be determined.

In Kolapis A, the ratio of male, female and hermaphrodite was 1: 1.04: 0.20 whilst in Segaliud Lokan it was 1: 1.75 : 0.46. The average ratio of these areas was 1: 1.24 : 0.28 of male, female and hermaphrodite (Table 1). This result shows that there were more female than male plants in the *C. subinermis* population. This is in contrary to the results obtained for *C. manan* or for *Salacca*. The percentage of flowering plants from the population was also high. This indicates that *C. subinermis* has a good reproductive strategy, and thus, is a good species for cultivation.

The analysis of variance shows that the sex expression of rattan is affected by site and provenance. The soil in Kolapis A (loam and clayey loam) is more fertile than that in Segaliud Lokan (sandy loam and sandy clayey loam) and hence the female expression is

higher in Kolapis A, which is shown in Table 1 and tested significant (p=0.05) by the Duncan's multiple range test. As reported in Lee (1995), favourable site conditions could enhance female sex expression. In this regard, the high female sex expression in this population might be due to the loamy soil type in the area which is more fertile than the coastal sandy soil on which *C. subinermis* normally grows.

The occurrence of andromonoecy was observed in individuals of all provenances planted (Table 1) and these individuals are mature plants producing canes, ranging 10–20 m in length. This indicates that the high ratio of hermaphrodite plants in this population is not a "juvenile trait" as suspected in Lee (1995). PEN provenance shows the highest number of flowering and hermaphrodite plants in this study; however, the percentage of the hermaphrodite plants is almost similar in most of the provenances observed (Table 1). Hence this andromonoecy phenomenon might be due to genetic factor.

Table 1. Sex of *Calamus subinermis* observed in Kolapis A and Segaliud Lokan

Site	Provenance	Male	Female	Hermaphrodite	Unknown	% of hermaphrodite
	KBE	31	48	11	12	10.78
Kolapis A	KIN	7	10	1	2	5.00
	KP	48	42	6	7	5.82
	PBA	1	-	-	-	-
	PEN	73	83	16	21	8.20
	PG	55	42	12	12	9.92
	PT	30	32	6	5	8.22
	TAM	46	35	7	4	7.61
	TAN	2	7	-	1	
	TUA	18	24	4	3	8.16
Total		311	323	63	77	
Segaliud	Brumas	1	1	2		50.00
Lokan	KBE	21	23	5	4	9.43
	KIN	5	9	2	2	11.11
	KP	8	24	7	3	16.67
	LAW		1			
	PEN	37	67	16	16	11.76
	PG	17	30	8	7	12.90
	PT	7	22	8	6	18.60
	TAM	12	27	4	7	8.00
	TAN	1	2			
	TUA	4	8	5	4	23.80
	SIP		1			
Total		123	215	57	49	

Note: KBE=Kota Belud, KIN=Kinarut, KP=Kuala Penyu, PBA=Pulau Berhala, PEN=Penampang, PG=Pulau Gaya, PT=Pulau Tiga, TAM=Tambunan, TAN=Tandik, TUA=Tuaran, LAW=Lawas, SIP=Sipitang.

The sex ratio shows that the planted *C. subinermis* population has more female than male and hermaphrodite plants. The occurrence of hermaphrodite plants in this population indicates that the present classification of *Calamus* species needs to be revised.

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