COCONUT LEAF-SPIRALS AND THEIR NON-GENETIC NATURE

Sifat arah putaran daun pada tanaman kelapa tidak diwariskan

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ABSTRACT

The leaves on a coconut crown are arranged in 5 spirals, all running clockwise in one palm, and counter-clockwise in another. The two types of palms in any plantation are distributed more or less equally. Data on the foliar spirality of the progeny obtained by different kinds of parental matings clearly show that the direction of foliar spiral in the coconut is not genetically determined. Additional data presented on 7860 palms show that the left-spiralled ones are in excess of the right-handeds.

RINGKASAN

Daun-daun pada mahkota kelapa tersusun atas 5 putaran yang semuanya searah dengan jarum jam pada satu tanaman, sedang pada tanaman lainnya arahnya berlawanan. Kedua macam tipe kelapa ini dalam suatu pertanaman tersebar dalam perbandingan yang kira-kira sama. Data putaran daun dari keturunan (progeny) yang diperoleh dari berbagai macam kawinan, jelas memperlihatkan bahwa arah putaran tersebut tidaklah ditentukan oleh sifat genetik. Data tambahan dari 7860 pohon kelapa menunjukkan bahwa arah putaran kiri lebih banyak dari pada putaran kanan.

LEFT - AND RIGHT-HANDED COCONUT PALMS

The leaves of the coconut (*Cocos nucifera* L.) are produced one after another (spiral phyllotaxis), the angle of deflection between any two consecutive leaves being about 138 degrees (Davis, 1962; 1963; 1964; 1971; Child, 1974; Patel, 1938; Menon & Pandalai, 1960; Fremond *et al.*, 1966). By following the production sequence of leaves, one can trace out a single spiral in a crown which is the genetic spiral. In addition to this, there are five clearcut spirals running opposite the single genetic spiral. In this communication we always refer to the five obviously visible spirals. All the five spirals in one crown veer clockwise, and in another, counter-clockwise (Davis, 1962; Child, 1974; Patel, 1938). There are also other ways of determining the direction of foliar spirals. If in a palm the spadix appears on the right side of its supporting leaf, the foliar spiral is left-handed. In a tree where the bunch appears on the left side of leaf, the palm is right-handed. The figure shows the two kinds of palms. On the basis of limited data relating to only 205 progeny of 4 pollen parents and 24 seed parents,

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Davis (1962) reported that the direction of foliar spiral in the coconut is not determined genetically.

PRESENTATION OF DATA AND CONCLUSION

At the research farms of the Industrial Crops Research Institute, Manado, there are large collections of parent palms and their progeny raised through different kinds of pollination. Some 25 years ago, A.F. Ihne and his colleagues effected controlled cross pollination between 41 selected palms (now about 52 years old) at the Mapanget Farm involving 49 parent-combinations. The foliar spirals of all the parents and the surviving 1023 progeny (now about 22 years old) at the Kima Atas Farm were checked and the data given in table 1.

Table 1. Foliar spiralities of parents and progeny.
Tabel 1. Putaran daun dari pohon induk dan keturunannya.

Parent-combinations *Kombinasi induk*	No. of combinations *Jumlah kombinasi*	Progeny *(Keturunan)*			
		Lefts *(arah kiri)*	Rights *(arah kanan)*	(L+R) *(kiri+kanan)*	(L−R) *(kiri−kanan)*
Left ♀ × left ♂	14	156	164	320	-8
Left ♀ × right ♂	13	150	130	280	20
Right ♀ × left ♂	10	131	89	220	42
Right ♀ × right ♂	12	115	88	203	27
Total	49	552	471	1023	81

As seen from the data in the Table 1, that 53.96% of the total progeny are leftspiralled. When we look for an association between segregation of progeny and parental mating type, we get an overall $x^2 = 6.41$ with 3 d.f. which is not statistically significant. However, the numerical superiority of left handed progeny brought about mainly by the right × left parental matings where the difference between the two kinds of progeny is significant, the x^2 value at 1 d.f. turning out to be 8.01. An explanation is being sought for this peculiarity. Also from the 41 parent palms mentioned above, over a thousand open-pollinated progeny were obtained and planted at the Kayuwatu Farm, Manado. Data obtained on 570 progeny of 19 seed parents are given in Table 2.

Table 2. Foliar spiralities of seed parents and open-pollinated progeny.
Tabel 2. Putaran daun dari pohon-pohon induk dan keturunannya hasil dari penyerbukan bebas.

Seed parents *Induk*	No. of palms *jumlah pohon*	Handedness of progeny *Arah putaran pada keturunannya* Lefts *(kiri)*	Rights *(kanan)*	Total
Left-spiralled *(putaran kiri)*	5	78	72	150
Right-spiralled *(putaran kanan)*	14	208	212	420
Total	19	286	284	570

It is clear from the data given in Table 2 that both the left-spiralled and right-spiralled mothers produce equal numbers of the two kinds of progeny nullifying any genetic influence controlling the asymmetry. At the Mapanget Farm, Manado, there are 3 palms (about 45 years old) which are the only survivors out of many progeny obtained by selfing some palms in private gardens around Manado. These three palms were again selfed and the F2 progeny planted at the Kima Atas Farm in three plots. The leaf spirals of the 41 survivors were examined and the data presented in Table 3.

Table 3. Foliar spiralities of mother palms and selfed progeny.
Tabel 3. Putaran daun dari pohon induk betina dan keturunannya hasil penyerbukan sendiri.

Seed parent *Induk*	Foliar spiral *Putaran daun*	Handedness of selfed progeny *Arah putaran dari keturunan hasil penyerbukan sendiri* Lefts *(kiri)*	Rights *(kanan)*	Total
G1 : 32/37	Left-spiralled *(putaran kiri)*	4	2	6
G2 : 10/37	Left-spiralled *(putaran kiri)*	15	13	28
G3 : 77/37	Right-spiralled *(putaran kanan)*	3	4	7
Total		22	19	41

The difference between the two kinds of progeny is not significant statistically, the x^2-value being 0.2195. This further shows that the foliar spirality is not genetically determined.

There is another sure way of checking whether the direction of coconut foliar spiral has genetical bearing. Exceptional coconuts produce aerial branches or suckers, and so, all the shoots of one such palm should have the same kind of foliar spiral if this character is genetic. Examination of a few such branching palms prove it otherwise, since all the shoots of the same palm are not similar. Production of bulbil-shoots is a rare phenomenon in the coconut. Recently Sudasrip *et al.* (1978) reported on two bulbil-producing coconut palms in Manado. Some of these bulbils were air-layered and transplanted in the field as clones. The spirality of these shoots was recorded and the data are shown in Table 4.

Table 4. Spirality of bulbil-shoots and that of mother palms.
Tabel 4. Putaran daun dari tanaman yang berasal dari tunas bulbil dan pohon-pohon induk betinanya.

Mother palm *Induk betina*	Spirality *Arah putaran*	Bulbil-shoots *(Tunas bulbil)* Lefts *(kiri)*	Rights *(kanan)*	Total
No. 1037	Left *(kiri)*	6	4	10
No. 1586	Right *(kanan)*	6	5	11
Total		12	9	21

Each mother palm produced bulbils which show the two kinds of asymmetry. This confirms that the direction of foliar spirals in the coconut is not genetically determined. We made a sample survey of palms at the hybrid seed garden at Paniki and in other farms of this Institute covering 7860 palms for their foliar spirals. The data are presented in Table 5.

With the exception of the Talls at Paniki, the populations in all the Farms have an excess of left-spiralled palms over the counterpart. This situation is similar to that reported by Davis (1974).

ASYMMETRY OF THE LEAF

Since the leaves are arranged spirally on the crown, the lamina should turn asymmetric resulting in a difference in the numbers of leaflets between halves of the same leaf. To verify this, 6 leaves each from six left-spiralled and six right-spiralled palms were lopped and the numbers of leaflets on halves counted. To determine the left and right halves, the leaves are always held vertically with the tip above. The left-hand side of the leaf as it appears to an observer viewing the abaxial surface (lower) is regarded as left half, and the other, the right half. The data are presented in Table 6.

Table 5. Left-and right-spiralled palms at LPTI Farms, Manado.
Tabel 5. Pohon-pohon kelapa yang memutar ke kiri dan ke kanan di Kebun Percobaan LPTI, Manado.

Location *Lokasi*	Spirality of palms *(arah putaran)* Lefts *(kiri)*	Rights *(kanan)*	(L+R) *(kiri+ kanan)*	(L−R) *(kiri− kanan)*	$\frac{(L-R)^2}{L+R}$
Paniki seed garden *(Kebun induk paniki)*					
Talls *(Dalam)*	1293	1331	2624	-38	0.5503
Dwarf *(Genjah)*	1544	1415	2959	129	5.6239
Kima Atas - Talls	552	471	1023	81	6.4135
Mapanget - Talls	372	312	684	60	5.2632
Kayuwatu - Talls	286	284	570	2	0.0070
Total	4047	3813	7860	234	6.9664

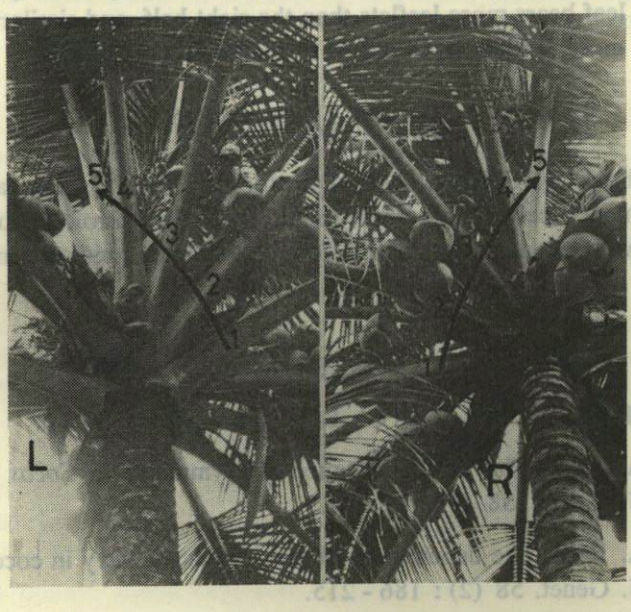

Figure 1. & 2. Crowns of left-spiralled (L) and right-spiralled (R) coconut palms. The consecutive leaves of one of the five spirals in each crown are numbered 1, 2, 3, 4.....etc.

Gambar 1. & 2. Kedudukan daun pada mahkota pohon kelapa yang berputar ke kiri (L) dan yang berputar ke kanan (R). Daun-daun yang memutar pada masing-masing mahkota secara berurutan dinomori 1, 2, 3, 4.....dan seterusnya.

Table 6. Numbers of leaflets on halves of leaves.
Tabel 6. Jumlah sirip daun pada separuh daun.

No. of palms *Jumlah pohon*	Spiral *Putaran*	No. of leaves *Jumlah daun*	Mean length of lamina. *Rata-rata panjang helaian daun*	Longest leaflets *(sirip terpanjang)* Left *(kiri)*	Longest leaflets *(sirip terpanjang)* Right *(kanan)*	Mean leaflets on halves *Rata-rata jumlah sirip pada separuh daun* Left *(kiri)*	Mean leaflets on halves *Rata-rata jumlah sirip pada separuh daun* Right *(kanan)*	Total	Difference *Beda*
6	Left *(kiri)*	36	4.28 m	1.37 m	1.37 m	118.94	116.95	235.99	1.99
6	Right *(kanan)*	36	4.39 m	1.34 m	1.37 m	117.14	120.03	237.17	2.89

When the five spirals are considered, in a left-spiralled palm the left half of the leaf bears more leaflets than the right half, and similarly, the right half bears more leaflets in a leaf of a right-spiralled palm.

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