

14th December, 1964.

Professor T. A. Davis,
Indian Statistical Institute,
203 Barrackpore Trunk Road,
CALCUTTA 35, INDIA.

Dear Professor Davis,

Recently I have had my attention called to an article in Nature, 30th May, 1964, by Satyabalan et. al. Their results appear to be at some variance with yours. However I note your original finding of non-inherited direction of spiral is confirmed. Your critics are sufficiently energetic to perform an experiment.

My critics prefer to find fault and explain how it should be done but decline to do anything.

I have been in correspondence with Dr. Robert Snow. He has been unable to give a full reference. We have gone to some trouble to examine early volumes of Berichte der Deutschen Botanischen Gesellschaft without result. If you encounter any other hints I will be pleased to learn the details.

I hope you continue with your studies of palm trees. In particular I'm interested in the possible change of left/right ratio with longitude.

Sincerely,

Greta Baker.

GR:JEG

(Reprinted from *Nature*, Vol. 202, No. 4935, pp. 927-928,
May 30, 1964)

Foliar Spiral and Yield in Coconuts

THE leaves of the coconut palm are arranged in five spirals which run in clockwise or anti-clockwise direction¹, the phyllotaxy of each spiral being nearly two-fifths². Patel³ mentions that in a majority of trees the direction of the spiral is towards the left. Observations⁴ on large numbers of palms from India and elsewhere, however, indicate that the distribution of 'lefts' and 'rights' is almost equal with a slight excess of 'lefts'. Available evidence⁵⁻⁷ also shows that the spiral character of the palms is non-inherited and probably not determined genetically.

Narayana⁸ was the first to examine the relationship between spiral character and yield of coconuts. From his observations on 70 trees selected at random from different yield groups, he concluded that the difference between the means of the two groups left and right was not significant, showing that the direction of the spiral has no bearing on yield. Davis⁹ from his examination of 128 'healthy palms' in the Central Coconut Research Station, Kayamkulam (a place affected by a devastating virus disease of coconuts), produced evidence to show that the left-spiralled trees give significantly higher yields than right-spiralled, a finding which he considers to be a novel biological fact. His own observations on 'moderate' diseased and 'severe' diseased palms from the same Station, however, did not reveal significant difference in mean yields of left- and right-spiralled trees. He, however, believes that "the figures for diseased trees, though not quite significantly different, strongly reinforce the significance of those for the healthy trees". In the same data published elsewhere¹⁰ Davis remarks: "The 'lefts' give 20.9 per cent excess yield of nuts over their counterpart, although it is based on a non-inherited character, and that is quite inexplicable. Among diseased palms also the difference is in the positive direction but not significant by itself. The number of the leaves of the 'lefts' is slightly greater and this may account, in part, for the increased yield of nuts of the 'lefts' . . ."

The foregoing finding of Davis is at variance with that of Narayana⁸. In view of the conflicting results reported, the relationship between foliar spiral and yield in coconuts was re-investigated by us, making use of the wealth of data available in the Central Coconut Research Station, Kasaragod, where meticulous details of yield characters, like number of spathes produced, female flower production, setting percentage, yield of nuts per bunch, etc., for

Table 1. MEAN YIELD OF NUTS (10 YEARS 1942-51)

Yield group	No. of trees		Yield	
	Right	Left	Right	Left
1 Low (below 40)	87	127	30.06	31.53
2 Medium (40-80)	288	334	57.63	57.04
3 High (above 80)	40	41	89.99	89.54
Total	415	502	54.9	53.2
	$\chi^2 = 2.65$		$\chi^2 = 0.0258$	
	$P = 0.2$		$P = 0.8$	

a few thousand trees for several years, are available. Data on yield of copra per palm per year, mean copra content per nut and oil content of copra for a few hundred trees have also been gathered. In Table 1 are presented data on yield of nuts of 917 trees belonging to different yield groups growing in the main block of the Central Coconut Research Station. A perusal of Table 1 shows that the yield of nuts of both 'lefts' and 'rights' in the three yield groups and the total as a whole is almost equal, the differences not being significant.

Data on annual production of leaves, nuts and copra as well as mean copra content per nut and oil percentage in 106 palms selected at random from among the 917 trees are presented in Table 2, which also do not indicate any significant differences between 'rights' and 'lefts' for any of the aforementioned characters.

The present results thus establish clearly and unequivocally that in the populations of coconuts investigated by us the left-spiralled trees show no superiority over the right-spiralled, either in yield of nuts or in any of the other characters investigated. Since the materials used in this investigation and that examined by Davis belong to the same variety of coconuts (West Coast tall) growing under almost identical climatic and soil conditions, it would be quite inconceivable if in one 'population' the 'lefts' show such a remarkable increase of 20.9 nuts over the 'rights' while in the other there is no indication of this superiority. It would thus appear that the reliability of Davis's claim has to be further verified from adequate data from a normal population of coconuts—especially in view of the fact that the pre-treatment data in the case of the healthy trees examined by Davis did not reveal significant difference between 'lefts' and 'rights' as was the case with the two diseased groups of trees. The futility of striving for explanations of phenomena that may not operate at all in Nature is well expressed in the pertinent words of

Table 2. SOME VARIATIONAL AND YIELD CHARACTERS IN COCONUTS

Character	Right (mean of 48 trees)	Left (mean of 67 trees)
1 Leaves	23.4	26.6
2 Yield of nuts	68.1	79.1
3 Copra/nut (g)	169.4	165.2
4 Annual out-turn of copra (kilos)	12.0	12.9
5 Oil percentage in copra	71.6	71.6

Prof. Preston quoted by Davis¹: "The connexion between the yield of coconut palms and the tilt of the conducting tissue is very intriguing indeed and is so unexpected as to be on the verge of the credible. Since the sign of the spiral is not inherited then one is compelled to assume that the orientation of the conducting tissue affects the disposal of the materials being conducted and I know of no mechanism which would incline me *a priori* to have believed such a phenomenon".

We thank Dr. K. M. Pandalai, director, Central Coconut Research Station, Kayamkulam, Kerala, for his advice.

K. SATYABALAN
C. A. NINAN
M. M. KRISHNA MARAR

Central Coconut Research Station,
Kasaragod,
India.

- ¹ Fetch, T., *Ann. Roy. Bot. Gard. Peradeniya*, 5, 538 (1911).
- ² Patel, J. B., *The Coconut: a Monograph*, 71 (Government Press, Madras, 1938).
- ³ Davis, T. A., *J. Genet.*, 58, 42 (1962).
- ⁴ *Rep. Agric. Stations, Madras Presidency for 1950-51* (Government Press, Madras, 1952).
- ⁵ Davis, T. A., *J. Genet.*, 58, 186 (1963).
- ⁶ Narayana, G. V., *Rep. Agric. Stations, Madras Presidency, 1940-41*, 414 (Government Press, Madras, 1942).
- ⁷ Davis, T. A., *Experientia*, 18, 521 (1962).