

29. THE SPIRALITY OF MAIN STEM AND ITS  
RELATIONSHIP TO THAT OF OFF-SHOOTS IN  
*EUPHORBIA ANTIQUORUM* LINN.

(With a text-figure)

The stem of some euphorbiaceous species twists either clockwise (left-handed) or counter-clockwise. This twisting is easily perceivable in stems bearing one or more wings, grooves, rows of leaves or spines. This brief report shows how the twisting of the main stem and that of the first order of off-shoots in *Euphorbia antiquorum* are related. In this species, the stem is a succulent cladode which bears three or four wings, each wing possessing pairs of spines at intervals and small caducous leaves. In many varieties of *E. antiquorum* the stem does not show any twisting, but in one variety, very common in south India, twisting of the stem is clearly noticeable (Fig. 1). Data were collected in January 1963

from a population of this variety in a village near Coimbatore, south India.



Fig. 1. Right- and left-twisting stems of *Euphorbia antiquorum*

1,500 main stems were examined of which two per cent showed a reversal of the twisting from one type to the other. A fraction of these showed double reversals as seen in Table 1.

TABLE 1

*Euphorbia antiquorum* : NATURE OF MAIN STEM

Left-handeds	..	748
Right-handeds	..	722
Left turning right	..	20
Right turning left	..	7
Left to right to left	..	3
Right to left to right	..	0

Total .. 1,500

50.88 per cent of the regularly twisting stems were left-handers. A further 200 main stems were cut randomly from a further lot of plants. As mentioned, the stem has either three or four wings at the 'internodal' region. Out of the 200 plants, 58 had four wings each and the rest three. The stem may produce one branch each from a wing, and so a four-winged stem may have four off-shoots although in many they may be reduced to 3, 2, 1 or nil. Similarly, a three-winged stem may have less than four or no off-shoots. The few stems producing no off-shoot were excluded. Very rarely a wing produced more than one off-shoot. In Table 2 details of the off-shoots produced from the 200 main stems are given.

TABLE 2  
*Euphorbia antiquorum*: NO. OF OFF-SHOOTS PER 'INTERNODE'  
(ALL WINGS) OF 200 MAIN STEMS

Main stem		Number of off-shoots									
		4-winged stems					3-winged stems				
Spiral	No.	4	3	2	1	Total	4	3	2	1	Total
Left	117	22	10	5	—	37	1	51	24	4	80
Right	83	12	8	—	1	21	—	43	15	4	62
Total	200	34	18	5	1	58	1	94	39	8	142

Like the main stems, the off-shoots also showed asymmetry by twisting either clockwise or conversely. A smaller percentage of these off-shoots, however, did not show any twisting and they were recorded as neutrals. From the 200 plants, 572 off-shoots were examined for their spirality and the data are given in Table 3.

TABLE 3  
*Euphorbia antiquorum*: DIRECTION OF OFF-SHOOTS OF 200 PLANTS

Main stem	OFF-SHOOTS							
	Left:		Right:		Neutral:			
	observed	%	observed	%	observed	%	Total	%
Left	243	71.26	72	21.11	26	7.62	341	100.00
Right	66	28.57	145	62.77	20	8.67	231	100.00
L+R	309	54.02	217	37.94	46	8.04	572	100.00

To find out whether there is a correlation between the kinds of twisting of the off-shoots and of the main stem, the observations were split up for the 4-winged shoots and 3-winged shoots and are presented in Table 4.

TABLE 4  
*Euphorbia antillarum*: ASYMMETRY OF OFF-SHOOTS IN  
RELATION TO MAIN STEM

Spiral of main stem	off-shoots	Nature of off-shoots			
		Left	Right	Neutral	Total
4-winged off-shoots (Total 198)					
Left	observed	.. 100	16	12	128
	percentage	.. 78:12	12:50	9:38	100:00
	percentage on all shoots	.. 29:32	4:69	3:52	37:54
Right	observed	.. 13	47	10	70
	percentage	.. 18:57	67:14	14:28	100:00
	percentage on all shoots	.. 5:63	20:35	4:33	30:30
3-winged off-shoots (Total 374)					
Left	observed	.. 143	56	14	213
	percentage	.. 67:14	26:29	6:57	100:00
	percentage on all shoots	.. 41:94	16:42	4:11	62:46
Right	observed	.. 53	98	10	161
	percentage	.. 32:92	60:87	6:21	100:00
	percentage on all shoots	.. 22:94	42:42	4:33	69:70
The expected values for all the groups have been calculated and given below :					
Main stem		Off-shoots			
		L	R	N	Total
Left	observed	.. 243	72	26	341
	expected	.. 183:212	129:365	27:423	
Right	observed	.. 66	145	20	231
	expected	.. 124:788	87:634	19:783	
Total	..	309	217	46	572

$$\chi^2 = 109.522$$

The value of  $\chi^2$  is highly significant both at the 5% and 1% levels, which clearly demonstrates the positive dependence of the off-shoots on the main stems with regard to the type of twisting. Similar values for the data relating to the 4-winged stems and 3-winged stems as given in Table 4 were calculated and in each case, the  $\chi^2$  value turns out to be highly significant even at the 1% level.

$$4\text{-winged off-shoots—}\chi^2 = 71.314$$

$$3\text{-winged off-shoots—}\chi^2 = 147.984$$

There is an interesting analogy to the above situation. In *Cordyline rubra* of Agavaceae, the leaves are arranged in two spirals, both of them running either clockwise or counter-clockwise in a shoot. The lamina is convolute in bud, rolling either clockwise or converse. In a shoot with right-handed foliar spiral, about 81 per cent of the leaves have right-handed convolution. In a left-spiral shoot, on the other hand, the convolution is about a similar percentage is left-handed (Davis & Ghosh, in press). However, in *Dieffenbachia* sp., the foliar spiral and convolution of the lamina in a plant move oppositely. In *Pothos scandens*, a leaf of left convolution is generally followed by a leaf of right convolution, and rarely by one with involute rolling (Davis, in press).

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