Xanthosoma: An Exhaustive Study

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Introduction

The dispersal patterns shown by angiosperms can be divided into two broad categories: seed dispersal and vegetative propagation. Dispersal by seed often involves elaborate mechanisms for dissemination. However the efficiency, in terms of number of adult offspring produced from the usually large numbers of seeds, is low because of the unsure seed placement and survival. Vegetative propagation is more efficient as the new plant is placed in a suitable environment, at least for the adult, but this method results in clonal spread and can only occur over a limited distance. Hence, in an area inhabited by relatively close together individuals of the same plant species, each plant may have arrived independently as a seed or may have been produced vegetatively from a neighbor. Individuals produced vegetatively from the same "parent" are more likely to be closely related phenotypically than those arising independently from seed. Therefore, phenotypic similarity of near neighbors may be a way of determining whether vegetative propagation has occurred.

The purpose of this field study was to try to determine which category of dispersal is being used by Elephant Ear (Xanthosoma, sp.), a large terrestrial aroid, in two different habitats. Araceae is a large family which contains herbaceous plants with aerial stems and underground tubers or rhizomes. We did not know if our species of Xanthosoma is capable of vegetative spread or, if it was, whether it employs this method to any detectable degree. We did know that the seeds are produced in large numbers, about 10,000 per infructesence, and are bat dispersed. Eric Dinerstein (pers. comm.) has determined that the seeds remain in the bat's gut for about 30 minutes.

The leaves of Elephant Ear are produced in a spiral pattern with an individual spiraling either clockwise or anti-clockwise. We assumed that this character is genetically determined. If the plants were totally seed dispersed there should be no relation between spiraling directions and nearest neighbor distances. If, however, spreading by tubers or rhizomes is important we would expect that plants close together would spiral in the same direction.

Methods

The study sites were located in an overgrown meadow over the Continental Divide from the Pensión Quetzal, Monteverde, in the valley of Peñas Blancas. The two sites were on opposite sides of the road. One site had a lot of surface water and the plants appeared to be in clumps. The second site was relatively dry and the plants appeared more evenly spaced.

In each site focal plants were selected (this plant was termed "Big Mama" by Eduardo) and the distances to the 5 nearest neighbors and the direction of spiraling of all 6 plants were recorded.

In addition, a few selected plants were dug up and examined for direct evidence of vegetative propagation.

Results

In the first (wet) study site, 89 plants were examined: 55 spiraled clockwise and 34 anti-clockwise. In the second dry site 120 plants were examined, 60 of which spiraled clockwise and 60 anti-clockwise. A X^2 test was carried out as follows. The data for spiraling direction were totalled separately for each of the five classes of successive nearest neighbors for the two sites. Each neighbor class was then tested against the expected proportions of spiraling direction calculated from the total results for each of the two sites. The null hypothesis was that the spiraling direction of neighbors was independent of the distance to the focal plants (see Table 1).

Therefore we rejected the null hypothesis for the first and fourth nearest neighbor class of the second site, but cannot reject it for all the other classes.

The mean distances between plants in the wet site was 45 cm and in the dry 77 cm. A histogram was plotted of the distance between neighbors and the percent of neighbors related (Fig. 1).

The plants that were dug up were found to have adjoining roots.

Discussion

From the X^2 we concluded that, with the possible exception of the first nearest neighbor in the dry site, there was no significant indication that nearer plants tended to be more related.

The histogram shows a possible trend of relatedness with distance but this result may be biased by the very small sample sizes in some of the classes. We therefore concluded that although vegetative spread may occur it was probably not an important phenomena in the dispersal of this Xanthosoma species.

It was interesting to note, however, that the two study sites, which were only separated by a few meters, were very different in the proportions of spiraling directions. This suggests that there may be limited gene flow between the two sites and that one direction may confer some survival advantage in one habitat but not in the other.

Table 1.

	Observed (O)	Expected (E)	O-E	X^2	
		WET SITE			
First nearest neighbor					
same direction	8	7.92	0.02	0.00005	
different direction	7	7.08	0.08	0.0009	
				0.00095	n.s.
Second nearest neighbor					
same direction	11	7.92	3.02	1.152	
different direction	4	7.08	3.08	1.340	
				2.492	n.s.
Third nearest neighbor					
same direction	7	7.92	0.92	0.107	
different direction	8	7.08	0.98	0.136	
				0.243	n.s.
Fourth nearest neighbor					
same direction	6	7.92	1.92	0.466	
different direction	9	7.08	1.98	0.554	
				1.020	n.s.
Fifth nearest neighbor					
same direction	9	7.92	1.02	0.131	
different direction	6	7.08	1.08	0.165	
				0.296	n.s.
		DRY SITE			
First nearest neighbor					
same direction	14	10	4	1.6	
different direction	6	10	4	1.6	
				3.2	$p < 0.1$
Second nearest neighbor					
same direction	9	10	1	0.1	
different direction	11	10	1	0.1	
				0.2	n.s.
Third nearest neighbor					
same direction	12	10	2	0.4	
different direction	8	10	2	0.4	
				0.8	n.s.
Fourth nearest neighbor					
same direction	6	10	4	1.6	
different direction	14	10	4	1.6	
				3.2	$p < 0.1$
Fifth nearest neighbor					
same direction	7	10	3	0.9	
different direction	13	10	3	0.9	
				1.8	n.s.

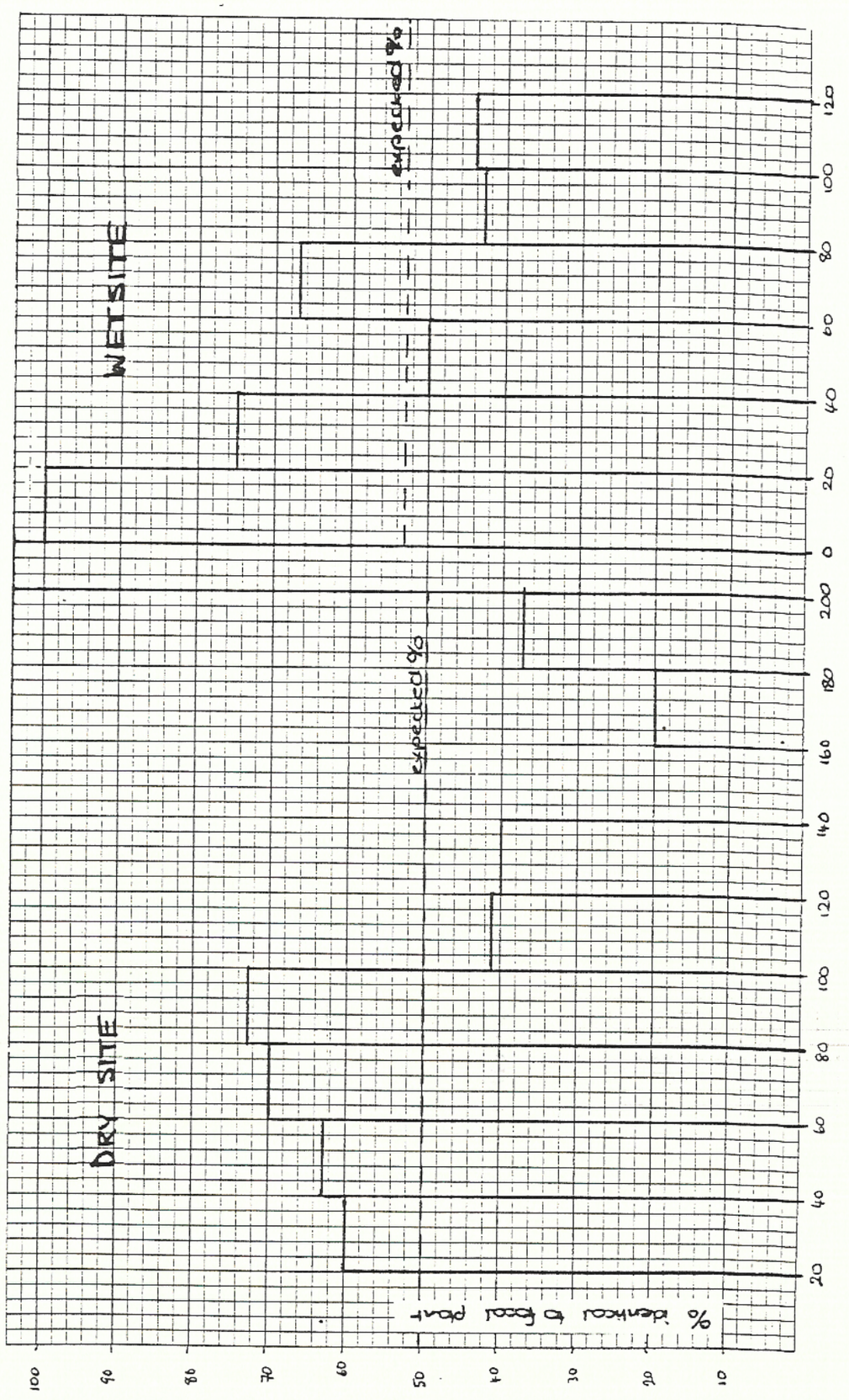

Figure 1. Histogram of distance between neighbors and percent related.