

LEAF STRUCTURE
OF A VENEZUELAN CLOUD FOREST
IN RELATION TO THE
MICROCLIMATE

by

Professor Dr. INGRID ROTH
Freiburg (Breisgau)

With 122 figures and 16 tables in the text

1990

GEBRÜDER BORNTRAEGER · BERLIN · STUTTGART

Contents

Introduction	1
Topography	1
Climate	2
Soil	5
Vegetation	5
The transitional cloud forest	6
The cloud forest proper	9
The upper cloud forest	12
Origin of the flora	14
Identification of species	15
Forest structure and diversity	16
Diversity	16
Forest structure	19
Mosaic structure of the forest	21
Forest stratification and some ecophysiological observations	22
Flowering	23
Leaf growth	24
Forest stratification and distribution of the biomass	24
Specific leaf area	25
Chlorophyll and nitrogen content	26
Light compensation point	27
Leaf morphology and anatomy of 80 species belonging to four different strata	
of the cloud forest	31
Material and methods	31
Vertical forest stratification and sampling	32
Species studied	32
Layer I: 5—40/60 m	32
Layer II: 1.30—5 m	35
Layer III: 1.30 m	38
Layer IV: 0—1.30 m	41

Leaf size in the different strata	43
Leaf shape in the different strata	49
Compound leaves	49
Simple leaves	50
The drip tip	51
Leaf symmetry	52
Stomata size and density in the different strata	53
Stomata density	53
Stomata size	56
Leaf anatomy in the different strata	89
Layer I	89
Layer II	94
Layer III	98
Layer IV	104
Discussion	114
15 monocotyledons of the undergrowth in stratum III and stratum IV	119
Species studied	119
Araceae	119
Arecaceae	119
Cyclanthaceae	120
Marantaceae	120
Musaceae	120
Leaf structure of the 15 monocotyledons	120
Araceae	120
Arecaceae	122
Cyclanthaceae	131
Marantaceae	133
Musaceae	134
Discussion of the results	134
Comparison with the 80 species studied in the four different forest layers	136
Stomata density and stomatal size	136
Mesophyll structure	137
Other important characteristics	137
Position of the leaf blade	138
Anatomical data of the 15 monocotyledons studied	139
The so-called “sleeping position” of the <i>Ctenanthe</i> leaves, an adjustment to minimal light intensities?	142
Four species of <i>Heliconia</i> studied by NAPP-ZINN & FRANZ	144
<i>Besleria disgrega</i> , a herb of the undergrowth	146

<i>Bauhinia</i> , a liana of the cloud forest	149
<i>Gyranthera caribensis</i> , the highest emergent tree in Rancho Grande	152
20 tree species of dicotyledons	158
Description of the species studied	158
Leaf surface area of the 20 dicotyledonous tree species	164
Leaf shape of the 20 arboreous species	165
Structural characteristics of the leaves of the 20 tree species studied	166
Description of the leaf anatomy of the 20 dicotyledonous tree species	189
Leaf structure as related to the height category of the tree	196
Giant herbs	196
Shrubs	196
Trees of medium height (10—20/25 m)	197
High trees (30—40/60 m)	199
Lianas	200
Hemi-epiphytes	201
Leathery consistence of leaves	201
Young and adult plants—shade and sun leaves	202
Structural characteristics due to the generic relationship	203
Slimy inner walls	205
Species of <i>Cecropia</i> and neoteny	205
Facultative invaders and the refuge theory	206
General discussion	207
Leaf size	209
Leaf shape	211
Position of the leaf blade	212
Stomata: density and size	213
Guttation	215
Inner leaf structure	218
The “omnipresent” leathery leaf?	221
Leaf consistence	222
Xero- and hygromorphy—sun and shade leaf type	223
Leaf of youth and leaf of the adult tree	226
Forest stratification and heterophylly	227
Comparison of the leaves of a low herb with those of the highest tree	227
Genetic characteristics	228
Leaf structure and the microclimatic gradient	230
Bibliography	234
General index	240
Author index	240
Index of scientific plant names	242