ATLANTIC ZONE PROGRAMME

Field Reports No. 63

MONILIA AND DIEBACK IN COCOA;

CAN THE COMPUTER HANDLE THE PROBLEM?

C.J. Tazelaar

April, 1991

CENTRO AGRONOMICO TROPICAL DE
INVESTIGACION Y ENSEÑANZA - CATIE

AGRICULTURE UNIVERSITY
WAGENINGEN - AUW

MINISTERIO DE AGRICULTURA Y
GANADERIA DE COSTA RICA - MAG

"Lo que preferiria hacer es cortar todos los árboles."

"Ellos (the governmental organisations) me prometieron un alto rendimiento, pero ahora solo tengo una grande deuda."

"Yo pense compar un auto, o una casa pero ahora solo pienso en retenerme."

"Es (the Monilia problem) la culpa de los negros. Ellos son demasiado perezosos para conservar bien sus árboles."

CONTENTS

1 INTRODUCTION

Cocoa (Theobroma cacao) is one of the twenty-two species belonging to the genus Theobroma, member of the Sterculiaceae family. Only T. cacao gives a product of commercial value. The cultivation of cocoa has been developed in several Central-American countries as an alternative for lowlands with a high precipitation and as a source of foreign currency. Actually cocoa is grown in the majority of tropical countries in a zone between 20° latitude South and 20° latitude North.

In the sixties and seventies the Centro Tropical de Investigacion y Enseñanza (CATIE) developed cocoa hybrids of the Trinitario type. Selection took place with an emphasis on yield and resistance to the diseases black pod rot (Phytophthora palmivora) and ceratostomella wilt (Ceratocystis fimbriata). These hybrids were distributed in Costa Rica and other Central-American countries. Expectations were high but soon two mayor constraints were revealed: first, yields fell far behind those obtained at CATIE fields and secondly, hybrids did not have tolerance to a new threat: Monilia disease (WAAIJENBERG & WESSEL, 1989).

Monilia disease of cocoa, also called watery pod rot, is caused by the fungus Moniliophthora roreri. The fungus attacks the cocoa pods in each stage of its development. At the end of 1978 the fungus was detected in the Atlantic Zone of Costa Rica. This year annual production was about 10.300 tons. In a few years production declined with 80 - 95 %. In 1983 production was no more than 1850 tons (GALINDO & ENRIQUEZ, 1984). Monilia disease caused the abandonment of many plantations or a change in culture.

To get a clear view on the factors limiting cocoa production in Costa Rica the Atlantic Zone Program of the CATIE/UAW/MAG started a detailed study on a limited number of trees in several farms in the Atlantic Zone. Relevant parameters discriminating the various factors influencing yield were measured in regular visits.

As was observed during these visits that shade was very uneven distributed in different fields (Figure 1) the idea was born to study this distribution in more detail. First the distribution of patterns of shade was simulated (TAZELAAR, 1990).

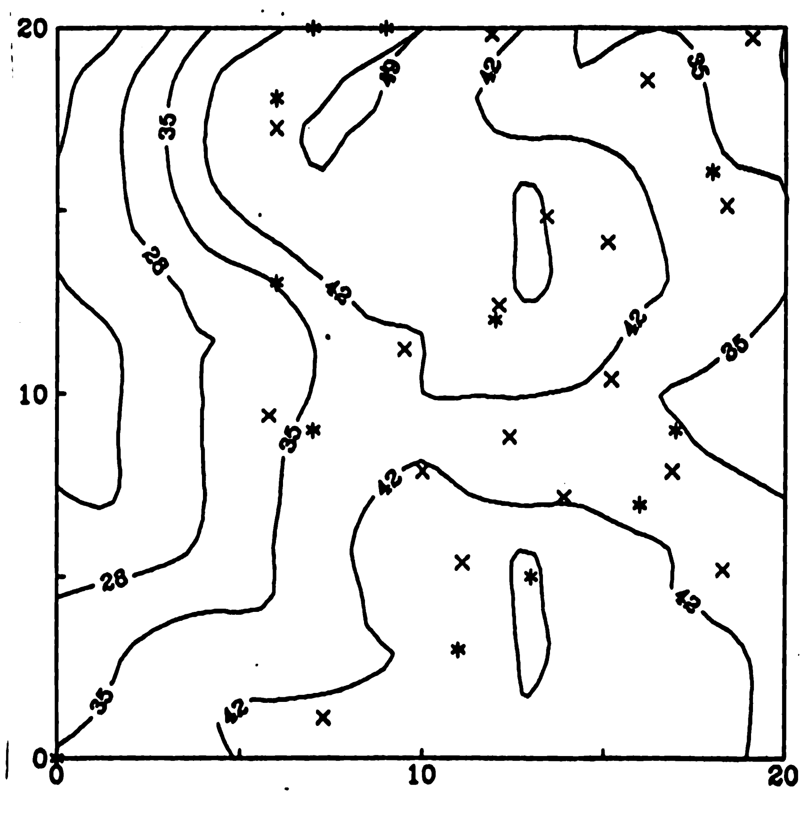


Figure 1. Simulated pattern in a cocoa-parcel.
(axes: coordinates, 21 : hours of shade, * : cocoa-tree, x : shade-tree)

Surprisingly little literature exists about planting patterns of shade trees. On the other side a lot of experiments have been done to examine the amount of shade cocoa needs. However, the way to calculate this amount mostly has not been described so data could be interpreted in different ways. Therefore the relation between shade and Monilia and shade and dieback which is well-known could not be studied too deeply.

In this report a computer program (QUESADA et al., 1987) has been used to simulate shade patterns in different fields. To compensate for the long time necessary for computing one week was simulated instead the months which divide each measurement. The simulated data were compared to the visual estimation and correlated to other characteristics.

To introduce the importance of shade for cocoa chapter two gives a general description of the role of shade. In chapter three the materials and methods are described. Chapter four concerns the results, chapter five the discussion and chapter six the conclusions.

2 THE ROLE OF SHADE

2.1 Introduction

In its natural habit cocoa (Theobroma cacao) is a small tree in the lowest storey of the evergreen tropical rainforest of South America. The use of shade is not only desirable in relation to a reduced amount of solar radiation. Other important factors are the regulation of several ecological factors like soil fertility, soil moisture, wind speed, air and soil temperature, relative humidity, diseases, pests and weeds. However, with adequate fertilization and disease, pest and weed control it is possible to obtain high yields without any shade trees (WOOD, 1986). But small scale farming does not allow for such practices, especially when prices of cocoa are low. Therefore much of the literature related to shade stays relevant.

2.2 Physiological effects

Light intensity effects size, thickness of leaves and chlorophyll content; leaves being greater and greener when grown under shade than when exposed to full sunlight. Young trees need a lot of shade because radiation heats the leaves which causes closing of the stomatas leading to a reduced water transport, reduced photosynthesis and early fall of leaves. The amount of sunlight a young tree receives influences its growth in the way that trees receiving a great amount of sunlight get shorter internodes, more fan branches, a low jorquette and a dense crown and thus a bushy appearance (WOOD, 1986).

Young leaves are very sensitive to moisture stress so growth will be more vigorous when the are grown under shade where relative humidity will be kept high and air movement reduced. This leads to a reduced transpiration and prevents de-hydratation.

The need for shade changes with age. A mature tree produces more leaves which will shade the underlying ones. This concept is known as self shading. When adequate quantities of fertilizer are applied and shade removed production will rise as a result of an increased photosynthetic rate. However, this can not be maintained for a long period as it seems to reduce the economic life of cocoa trees. The soils of the survey area are chemically poor and non-fertilized. For these types of soils about 50 % of shade is recommended (CUNNINGHAM & BURRIDGE 1960, ENRIQUEZ 1975, EVANS & MURRAY 1953, JIMENEZ 1980, MARTINEZ & ENRIQUEZ 1984, PURSEGLOVE 1987, WESSEL 1986).

2.3 Relation with diseases

There exists a relation between high precipitation and the incidence of *Monilia*. Therefore, given a micro climate with favourable conditions for the development of the fungus (poor drainage, high relative humidity and relative low temperatures), as under dense shade, spore production will be high (LASS, 1986).

On the other hand, cocoa trees exposed to full sunlight are severely attacked by dieback, a complex of effects caused by capsids, attack of thrips, fungus activity, viruses (swollen shoot disease) and related with low soil fertility, inadequate water-supply and exposure to wind (KAY, 1961, LASS, 1986).

Figure 2. Cocoa-tree severely affected by dieback.

3 MATERIALS AND METHODS

3.1 Selection of sites

The experiment took place in the Atlantic Zone of Costa Rica. The region was divided in two parts: the Pococi and Guácimo cantons and the Sixaola district. This differentiation was based upon differences in climate and soil (see also TABLE 1).
For this experiment 20 farmers were selected. Selection took place with the help of data provided by the Ministerio de Agricultura y Ganáderia (MAG) and the Instituto de Desarollo Agrario (IDA). First farmers were selected according to the following criteria:

* they must have cocoa of the F2 type (hybrids)
* the trees must be older then four years
* they must handle their whole field in the same manner

According to these requirements ten farmers in each region were selected at random. The selected farmers were asked to indicate a good and a bad part in their field and for their reason for this distinction. The size of the indicated parts was 15 * 15 m. Depending on plant pattern this corresponds to 15 to 28 cocoa trees.

TABLE 1. Socio-economic characteristics of the two regions.

The cantons Pococí and Guácimo

- Relatively early settlement, since the second half of the 19th century
- Strong influence of banana companies on land, market, employment and infrastructure.
- The relatively well developed railway and road connections with San José and Límon.
- A pronounced presence of government and semi-government organisations
- The redistribution of land by settlement schemes, land invasions and by buying and selling
- The diversification and intensification in cropping and livestock systems

The Sixaola district

- A population of Amerindian, African and more recently of Spanish origin, each with their own culture or way of living and farming
- Relative isolation from the rest of the country, resulting in little integration with the national economy and a strong orientation towards export markets.
- A vulnerable economy depending on a few cash crops (banana,plantain, cocoa), and lack of alternative activities and emplcyment opportunities
- The recent and ongoing improvement of the infrastructure, related to oil and pitcoal exploration

3.2 Measurements

3.2.1 cocoa

The following tree characteristics were measured or calculated:

1) coordinates of the tree in the plot
2) stem-surface
3) height of the jorquette
4) crown surface
5) stem surface - crown surface ratio
6) dieback
7) pods with *Monilia*
8) total number of pods
9) incidence of *Monilia*

Way of measuring:

The **coordinates** of each tree were measured from the south west corner:
Abscise (X) : direction East-West
Ordinate (Y) : direction North-South

stem-surface was calculated with the help of the formula $A = 0.5*\pi*D^2$ after measuring stem-diameter at a height of 30 cm above soil-level.

The height of the jorquette was measured from soil level up to the jorquette and thus the same as the height of the stem.

Crown surface was calculated. First the shortest and longest fan branch were measured. This was done by measuring from the jorquette to the end of the far most leave of the shortest and longest fanbranch. The average value gives the average crown radius. Using the formula $A = 2*\pi*r^2$ this transformation was completed.

Dividing (2) by (4) the **stem surface - crown surface ratio** was calculated (=tree-ratio).

Dieback was estimated and placed in different classes. For determination the side branch, mostly affected by dieback was taken as a representative of its fan branch.

Classes are:
- 0 - not effected by dieback
- 1 - dieback 0 -10 cm
- 2 - dieback 11 -20 cm
- 3 - dieback 21 -30 cm
- 4 - dieback more than 31 cm

The number of pods with symptoms of Monilia and sporulating pods were counted.

The **total number of pods** were counted.

The **incidence of** Monilia was calculated by dividing 7 by 8.

3.2.2 shade trees

1) name of the tree (APPENDIX 1)
2) coordinates of the tree in the plot
3) form of the crown
4) height of the stem until the base of the crown
5) radius of the crown
6) height of the crown (APPENDIX 2)

Way of measuring:

The coordinates were measured in the same way was done with the cocoa trees.

The **form of the crown** was observed and put into classes:

1 spherical
2 ellipsoid (vertical)
3 conical
4 semi-spherical
5 semi-ellipsoid

Height of the stem: based upon the distance between observer and the stem, the angle between the ground and stem and the height of the observer.

The radius of the crown was measured in the same was done with the cocoa-trees.

The height of the crown was measured in the same way as the height of the stem.

3.3 Calculations

First, six farmers were selected at random. For each parcel (good and bad) the pattern of shade was simulated during one week, instead of the two months between two observations. Because there were four observations this resulted in 48 simulations. The results were related to the position of the cocoa-trees. For each observation correlations of amount of shade with dieback and Monilia were calculated. To study the presence of the diseases in more detail several tree, soil and management characteristics were included in the study.

The required inputs for the simulation-program are:

- initial day of simulation (dd/mm/yy)
- final day of simulation (dd/mm/yy)
- periodicity of daily movement (days)
- latitude (degrees, minutes, north or south)
- start of daily simulation (hours, minutes)
- end of daily simulation (hours, minutes)
- type of plot (horizontal or inclined), maximal slope and direction of the slope with regard to the north (°)
- dimensions of the plot and gridsize (m)
- number of shade trees (n)
- characteristics of each tree:
  coordinates, form of the crown, height of the stem to the base of the crown, radius of the crown, height of the crown (m)
- print data matrix?
- print hours of overlap of shade
- storage of output: disk, files, extension

4 RESULTS

4.1 Shade patterns

The average values for all simulated plots are presented in TABLE 2.

To illustrate the differences in one field the distribution of hours of shade as a percentage are presented in Figure 3.

Period of simulation	Average (hours)	Standard Deviation
November-December	36.6	13.41
January -February	37.8	13.63
March -April	37.4	13.00
May -June	38.4	11.91
Average	37.5	11.02

TABLE 2. Average amount of shade in all simulated plots.

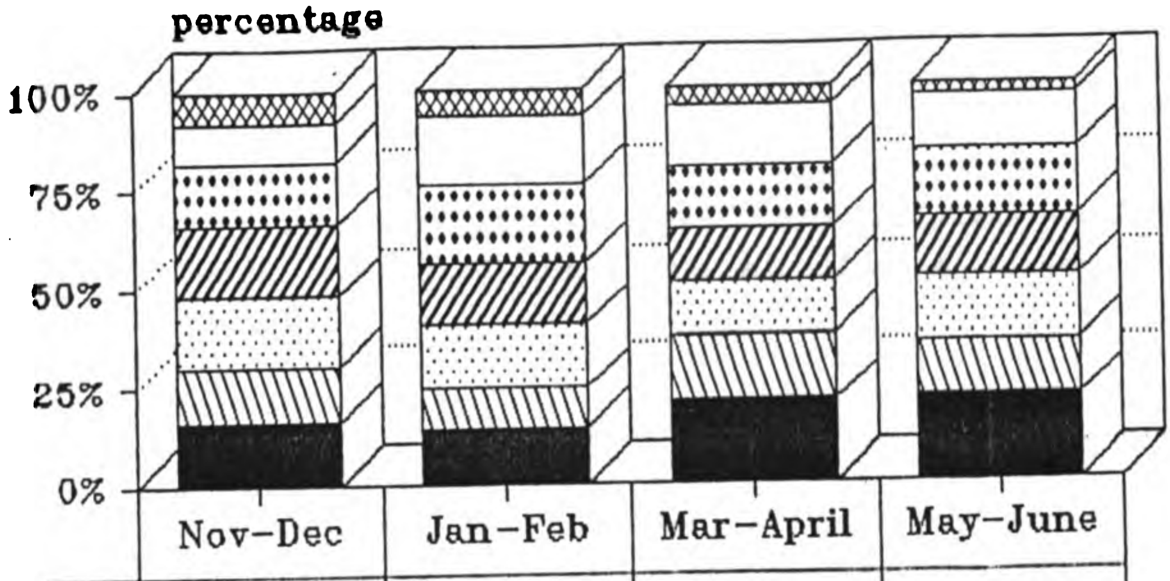
4.2 Dieback

Correlation between simulated amount of shade and severity of dieback were 0.13, -0.03, -0.27 and -0,01[1] respectively. The third estimation was significant at the 0.01 level. A negative correlation is expected, the more the amount of shade the smaller the severity of dieback. Other results are presented in TABLE 3.

Period of simulation	Average	Standard Deviation
November-December	1.06	1.32
January -February	1.35	1.71
March -April	2.00	1.84
May -June	0.67	1.26
Average	1.27	1.26

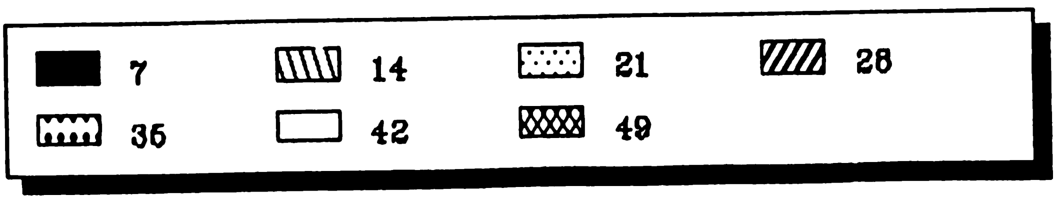
TABLE 3. Average severity of dieback.

[1] 208 observations.



	Nov-Dec	Jan-Feb	Mar-April	May-June
49	0,08	0,07	0,05	0,03
42	0,1	0,17	0,15	0,14
35	0,16	0,2	0,16	0,17
28	0,18	0,16	0,13	0,15
21	0,18	0,16	0,14	0,17
14	0,14	0,1	0,17	0,14
7	0,16	0,14	0,2	0,21

time of simulation



hours of shade

Figure 3. Distribution of simulated hours of shade in a plot.

When dieback was correlated with the visual estimation of the amount of shade in all the plots correlations were -0.45, -0.37, -0,33 and -0,30[2] respectively. This estimation was done for the whole plots in November. Only the first correlation was significant at the 0.01 level.

To study the influence of soil and tree characteristics several correlations were calculated. Only the significant values are presented in TABLE 4.

Variable	Correlation
drainage	-0.39
Ca	-0.48
Mg	-0.45
C.E.C.	-0.42
Ca+Mg+K	-0.47
Base saturation	-0.39
Shade (visual)	-0.40
tree-ratio	0.75

TABLE 4. Correlation of several variables with the average severity of dieback.

4.3 Monilia

Period of simulation	Average	Standard Deviation
November-December	0.04	0.15
January -February	0.23	0.43
March -April	0.27	0.38
May -June	0.26	0.38
Average	0.20	0.26

TABLE 5. Average incidence of *Monilia.*

[2] 38 observations.

When the amount of diseased pods was correlated with the simulated amount of shade correlations were -0.76, -0.88, -0.73 and -0.57 respectively. The first and third observation were significant at the 0.01 level and the second at 0.001 level. When the incidence was calculated correlations were -0.49, 0.01, 0.21 and -0.25 respectively. A positive values was expected, the greater the amount of shade, the greater the incidence of *Monilia.*
There were no significant correlation with tree and soil-characteristics although correlations of *Monilia* with stem and crown were rather high.

4.4 Survey

Some results of a survey carried out in August 1990, concerning the control of disease are presented here.

Most important pod-diseases:	
Monilia, *Phytophthora*	72%
Phytophthora, *Monilia*	11%
only *Monilia*	11%
only *Phytophthora*	6%
Control of pod-diseases:	
no control	11%
cut pod, leave on ground	72%
cut pod & bury	6%
cut pod & out of plot	6%
cut pod&out of plot& bury	5%
Chemical control of pod-diseases:	
no	89%
yes	11%
Existence of other diseases:	
no	17%
anthracnose	47%
dieback	6%
dieback & anthracnose	11%
Ceratocystis wilt	6%
unknown	13%
Manual control of other diseases:	
no	89%
yes	11%

5 DISCUSSION

5.1 Simulated shade patterns

Table 2 show the difficulty of using average values. When data were averaged using all simulated plots there is no obvious difference between the observations. All observations have an average of about 37.5 hours and a standard deviation of 13. It means that 75% of the time a point receives shade. This is clearly a large percentage and gives without further knowledge of the existing situation rise to the thought of a high incidence of Monilia and small amount of dieback. Figure 3 indicates the difference between the observations. The correlation between different observation varied between 0.90 and 0.99, indicating the pattern did not change too much. Differences do not seem to be large but one should remember only one week is simulated and only from 09.00 A.M. to 15.00 P.M, every hour. Increasing the simulated time, decreasing the hourly interval and the gridsize will reveal larger differences. This leads to a careful consideration of the program being used. One very important factor is that hours of sunshine is not the same as solar energy and the influence of diffuse light is neglected. Further, the program assumes all over the day which is often not correct.

5.2 Dieback

The correlations found, illustrate the remarks mentioned above. Although shade seemed to be even distributed over the year, the severity of dieback and it's correlations with shade varied clearly. The positive correlation of 0.13 was not expected. Sampling error seems hard to justify because severity of dieback was measured accurately. The method of measuring is due to doubts but as other correlations are negative this is not considered to be the cause of the positive value.

The simulated pattern is able to cause this value which indicates that climatic data are different from the simulated data. The visual estimation gives a different picture. All correlation are negative and decreasing as time passes by. This could be explained when it is assumed that the pattern of shade changes in time. It would be interesting to consider the observations later in time to see if the pattern is in accordance to the chancing seasons.

When the values of the dieback severity are averaged and correlated with tree and soil characteristics the influence of the calcium and potassium amount and a water-logged soil is pronounced. The results correspond well with the theory as described in chapter 2.3. A very interesting correlation is the one with the tree-ratio. There are many factors influencing this ratio. It could be explained by the nutrient and soil-moisture status,by the genetic material, or by an incorrect pruning method. This is an interesting option for further research.

5.3 Monilia

Results were rather disappointing. negative correlations were not expected, incidence varied greatly and soil-characteristics did not seem to influence the presence of Monilia. Interesting was the fact that the presence of Monilia correlated with the presence one or two observations before. This seems to confirm the findings of the author who noted the importance of an existing source of inoculum (TAZELAAR, 1991). The cause of this negative correlations should be studied in more detail. One should not forget the plots were not experimental plots but farmers do interfere the results. Especially in the case of Monilia which is treated regularly, "disturbing" an expected pattern. Further plots are not treated equally and observations were done in different parts of the production-cycle. It is possible one plot was just completely cleaned of Monilia and one plot was forgotten one time. The climate is characterized as "very wet,high relative humidity (85 - 905%), hot, without a dry period, so the climatic circumstances are ideal for Monilia the whole year.

6 CONCLUSIONS

The simulation-program used in this report has some constraints as was mentioned in chapter 5.1. When input is more detailed the use of the program can be very useful to study the influence of shade on certain characteristics. When a variable is subject to change continuously (as is Monilia in a farmers plot) results become unpredictable. A suggestion for further use is the study of vegetative growth of the cocoa-tree. When results of the survey are studied it appears farmers do not take too much care of diseases. They are aware of the importance of pod-diseases but do not control them very accurately. It seems some of the statements in the preface are characteristic. People are promised a lot of money by growing cocoa, but they seem to forget the tree needs a lot of care.

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APPENDIX 1 NAMES OF SHADE TREES.

1	Anonillo	Annona sp.
2	Aguacate	Persea americana
3	Balsa	Ochroma lagopus
4	Banano	Musa AAA
5	Banano criollo	Musa AAA
6	Cacao viejo	Theobroma cacao
7	Carambola	Averrhoa carambola
8	Cedro	Cedrela mexicana
9	Coco	Cocos nucifera
10	Crotón	Codiaeum variegatum
11	Gavilán	Pentaclethra macroloba
12	Guanacaste	Enterolobium cyclocarpum
13	Guavo	Inga spp.
14	Guanabana	Annona muricata
15	Hiquerilla	Ricinus communis
16	Hule silvestre	Castilloa elastica
17	Indio desnudo	Bursera simaruba
18	Javillo	Hura crepitans
19	Lagartillo	Zanthoxylum insulare
20	Laurel	Cordia alliodora
21	Limón acido	Citrus aurantifolia
22	Madero negro	Gliricidia sepium
23	Mango	Mangifera indica
24	Manzana de aqua	Eugenia malaccensis
25	Manzana rosa	Eugenia jambos
26	Melina	Gmelina árborea
27	Nuez muscada	Myristica fragans
28	Naranja	Citrus sinensis
29	Níspero	Manilkara achras
30	Palma africana	Elaeis guineensis
31	Pejibaye	Bactris gasipaedes
32	Platano	Musa AAB
33	Poró	Erythrina glauca
34	Poró gigante	Erythrina poeppigiana
35	Tamarindo	Tamarindus indica
36	Teca	Tectona grandis
37	Toronja	Citrus spp.
38	Yuca	Manihot esculenta
39	Yumplón	Spondias dulcis
40	Zapote	Calocarpum mammosum
41	Unknown	

APPENDIX 2 DIMENSIONS OF SHADE TREES.

Name	#	Crown-height	S.D[3].	Stem-height	S.D.	Crown-radius	S.D.
Population:	580	7.3	6.2	6.9	6.5	4.2	2.2
Anonillo	1	30.1	0.0	23.3	0.0	6.0	0.0
Aguacate	20	5.5	2.8	3.9	2.0	3.8	4.0
Balsa	11	6.8	6.1	8.1	5.2	4.5	1.8
Cacao viejo	33	2.2	0.7	2.9	0.9	3.6	0.7
Carambola	1	8.7	0.0	1.0	0.0	5.0	0.0
Cedro	40	9.9	7.3	9.1	4.8	4.8	2.2
Coco	24	7.2	2.6	4.5	1.6	5.0	1.4
Croto	10	4.3	1.1	4.5	2.0	3.9	1.3
Gavilan	3	10.3	5.4	8.9	5.6	6.3	1.5
Guanacaste	2	29.3	0.0	24.1	0.0	11.0	0.0
Guavo	71	8.1	5.7	7.2	4.6	6.2	2.0
Guanabana	2	4.0	4.6	3.5	1.1	4.5	3.5
Hiquerilla	11	4.7	.7	3.9	0.6	3.2	0.4
Hule silvestre	9	16.5	8.2	10.2	8.0	6.6	3.1
Indio desnudo	6	6.5	4.1	6.7	2.4	3.8	0.9
Javillo	14	10.3	5.1	8.0	3.0	6.2	3.2
Lagartillo	1	18.0	0.0	15.5	0.0	3.0	0.0
Laurel	97	9.3	.8	12.6	10.9	3.1	1.4
Limon acido	1	2.4	0.0	2.0	0.0	2.0	0.0
Madero negro	26	6.7	5.1	4.9	1.5	4.7	1.5
Mango	1	7.5	0.0	2.5	0.0	3.0	0.0
Manzana de agua	1	10.7	0.0	7.6	0.0	5.0	0.0
Manzana rosa	3	2.2	0.2	1.3	0.2	1.6	0.5
Melina	13	4.6	2.0	3.4	1.0	2.8	0.8
Moscadero	4	7.1	3.6	1.2	0.5	1.2	0.5
Naranja	10	4.5	1.6	2.9	0.8	2.9	1.1
Palma africana	2	8.5	2.2	5.7	6.0	5.5	4.9
Pejibaye	7	6.9	4.1	5.5	1.3	3.2	1.3
Poró	34	5.8	4.5	5.1	3.2	4.9	1.9
Poró gigante	6	14.2	9.4	5.8	3.5	5.1	1.6
Tamarindo	1	7.2	0.0	8.8	0.0	4.0	0.0
Teca	2	5.6	3.9	6.1	4.5	3.5	0.7
Yuca	6	1.6	.0	2.0	0.0	1.0	0.0
Yumplon	1	9.7	0.0	6.2	0.0	4.0	0.0
Zapote	3	7.4	7.4	5.9	1.4	4.3	1.1
Unknown	35	12.1	8.9	10.2	6.5	5.6	2.0

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[3] Standard Deviation.

APPENDIX 3 COMPUTERPROGRAMS

```
* getting the data.
   TRANSLATE FROM = 'c:\kees\samenv.wk1'
   /FIELDNAMES.
   SAVE FILE = 'c:\kees\samenv.sys'.
   GET FILE  = 'c:\kees\samenv.sys'.
   MISSING VALUES ALL ( ).
* calculate soilproperties.
   COMPUTE sum      = (ca+mg+k).
   COMPUTE ratio1   = ca/mg.
   COMPUTE ratio2   = (ca+mg)/2.
   COMPUTE basesat  = (sum/cec)*100.
* calculate treeproperties.
   COMPUTE treerat  = stam/kruin.
   COMPUTE mravg    = (mr1+mr2+mr3+mr4)/4.
   COMPUTE monavg   = (mon1+mon2+mon3+mon4)/4.
   COMPUTE inc1     = mon1/tot1.
   COMPUTE inc2     = mon2/tot2.
   COMPUTE inc3     = mon3/tot3.
   COMPUTE inc4     = mon4/tot4.
   COMPUTE incavg   = (inc1+inc2+inc3+inc4)/4.
   RECODE inc1       (SYSMIS =0).
   RECODE inc2       (SYSMIS =0).
   RECODE inc3       (SYSMIS =0).
   RECODE inc4       (SYSMIS =0).
   RECODE incgem     (SYSMIS =0).
* coding the classes.
   RECODE shade    (0 THRU 30=1)(31 THRU 70=2)(71 THRU HI =3).
   RECODE mrgem    (0=1)(0.01 THRU  2=2)(2 THRU 4=3).
   RECODE dren     (2,3 =1)(4,5=2).
   RECODE sum      (LO THRU 10=1)(10 THRU HI=2).
   RECODE ph       (LO THRU 5.2=1)(5.3 THRU 6.3=2(6.4 THRU HI=3).
   RECODE ratio1   (LO THRU 4=1)(4 THRU HI=2).
   RECODE ratio2   (LO THRU 15=1)(15 THRU 25=2)(25 THRU HI =3).
   RECODE cec      (LO THRU 35=1)(35 THRU HI=2).
   RECODE basesat  (LO THRU 45=1)(45 THRU HI=2).
   RECODE limi     (LO THRU HI=1)(SYSMIS=2).
   RECODE prof     (LO THRU HI=1)(SYSMIS=2).
* assigning labels.
   VARIABLE LABELS
   prod         'producer'
   gram         'grasses'
   hoan         'broadleaf'
   dren         'drainage'
   prof         'spots'
   limi         'rootzone'
```

```
VALUE LABELS
      shade    1 '0-30%'       2 '30-60%'            3 '60-100%'
      /mrgem   1 'no'          2 'dieback <20cm'     3 'dieback >20cm'
      /ph      1 'acid'        2 'optimal'           3 'basic'
      /sum     1 'bad'         2 'satisfying'
      /ratio1  1 'good'        2 'bad'
      /ratio2     1 'bad'      2 'reasonable'        3 'satisfying'
      /cec        1 'satisfying'     2 'good'
      /basesat    1 'bad'            2 'good'
      /lote       1 'bad'            2 'good'
      /limi       1 'shallow'        2 'good'
      /prof       1 'wet'            2 'good'
      /dren       1 'bad'            2 'good'
      /enferm     1 'monilia'        2 'maznegra'
      /control    1 'no'             2 'cut'               3' bury'
      /manual     1 'yes'            2 'no'
      /quimic     1 'yes'            2 'no'.
```