ATLANTIC ZONE PROGRAMME

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BLACK SIGATOKA APPEARANCE IN PLANTAIN IN RELATION TO DISEASE CONTROL AND FARM MANAGEMENT

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Figure 1. Location of the study area.

PREFACE

General description of the research programme on sustainable Landuse.

The research programme is based on the document "elaboration of the VF research programme in Costa Rica" prepared by the Working Group Costa Rica (WCR) in 1990. The document can be summarized as follows:
To develop a methodology to analyze ecologicaly sustainable and economically feasible land use, three hierarchical levels of analysis can be distinguished.
1. The Land Use System (LUS) analyses the relations between soil type and crops as well as technology and yield.
2. The Farm System (FS) analyses the decisions made at the farm household regarding the generation of income and on farm activities.
3. The Regional System (RS) analyses the agroecological and socio-economic boundary conditions and the incentives presented by development oriented activities.

Ecological aspects of the analysis comprise comparison of the effects of different crops and production techniques on the soil as ecological resource. For this comparision the chemical and physical qualities of the soil are examined as well as the polution by agrochemicals. Evaluation of the groundwater condition is included in the ecological approach. Criterions for sustainability have a relative character. The question of what is in time a more sustainable land use will be answered on the three different levels for three major soil groups and nine important land use types.

Combinations of crops and soils

	Maiz	Yuca	Platano	Piña	Palmito	Pasto	Forestal I II III
Soil I	x	x	x		x	x	x
Soil II						x	x
Soil III	x			x	x	x	x

As landuse is realized in the socio-economic context of the farm or region, feasibility criterions at corresponding levels are to be taken in consideration. MGP models on farm scale and regional scale are developed to evaluate the different ecological criterions in economical terms or visa-versa.

Different scenarios will be tested in close cooperation with the counter parts.

The Atlantic Zone Programme (CATIE-AUW-MAG) is the result of an agreement for technical cooperation between the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), the Agricultural University Wageningen (AUW). The Netherlands and the Ministerio de Agricultura y Ganadería (MAG) of Costa Rica. The Programme, that was started in April 1986, has a long-term objective multidisciplinary research aimed at rational use of the natural resources in the Atlantic Zone of Costa Rica with emphasis on the small landowner.

Preface

In the period between the 20th of April and the 24th of July 1992, I participated in the activities of The Atlantic Zone Programme.

This period could not be successful without the help of many people. I would like to thank Herman Frinking and Robert Power who made it possible for me to come to Costa Rica. During my work, I had great support from José Galindo who supervised my investigation. At the CORBANA station in La Rita, I would like to thank Doughlas Marin for sharing his knowledge about black Sigatoka.

But most of all, I would like to thank my dear friend Oswaldo Torres for his support, enthusiasm and friendship. Maud, Adri, Joop and Folkert, I learnt a lot in Costa Rica,

Jeiger de Vriend

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1 Plantain cultivation in The Atlantic Zone

1.1 Introduction

In contrast to banana, plantain cultivation looks insignificant. Plantain is mainly cultivated on smaller scale, on remote fields and small farms. But plantain contributes directly to the subsistence of thousands of families in The Atlantic Zone of Costa Rica (Bouma,1991).

For export and local market production purposes, in this area, plantain is mainly cultivated in a monoculture, although mixed cropping systems with cocoa trees and some food crops also exist. At the same time, plantain is also found in many backyard cultivation systems, providing families directly with one of the cheapest sources of starch which can be produced (Montcel,1987). It must be clear that plantain cultivation is of great importance in The Atlantic Zone.

1.2 Management

In general we distiguish three cultivation systems: backyard cultivation, small scale cultivation and intensive cultivation. Of course, only small scale and intensive cultivation are of economical importance to the area, since in the case of backyard cultivation the bunches are consumed locally. With both small scale and intensive cultivation, the plantains produced are intended for the nearest large urban centre or for export (Montcel,1987). These systems require more management of course, also because mechanization is highly desirable to lower production costs. In cooperation with extension services, small scale producers get advice about fertilization and disease control. Many intensive cultivators do their own investigations on these subjects.

An issue in the plantain management might be the choice of plantain variety. The most cultivated variety in The Atlantic Zone is Curraré, only on a few farms Dominico, much smaller and thinner but with a much better taste, is cultivated. They differ in various ways, but most important is the difference in cropping cycle. For Dominico this is 24 months per cycle.

The few plantations with Dominico only produce for the American market, because there hardly is a good national market for this variety; the prices are too low. Another important issue is the plant density. The average plant density is 1800 pl/ha (CORBANA,1992), although certain farms are doing experiments with a Colombian high density system of 5000 pl/ha.

1.3 Economics

Plantain is cultivated for different markets. A small part of the production is used for autoconsumption. The majority of the plantains is for the national market and is consumed in the cities of the Central Valley: San José, Heredia, Alajuela and Cartago. There are two million people living in this area, two thirds of the total population of Costa Rica.
In general the plantains are brought there by truck (Bouma,1991).
The average yield is 16.39 kg/bunch, and the average price per box of 23 kg is $ 9 (CORBANA,1992). The price depends on the stage of development and the quality of the fruit. Plantains of minor quality are sold as "two-for-one" or "three-for-one". Various intermediates buy single fingers and sell them later as mature bananas.
During the last decade, plantain cultivation increased for export purposes. Associations of small producers were founded. They commercialized the product and demanded strict management conditions of the fields and the product quality. At the same time, various projects were initiated for plantain export to the United States and Europe. The banana cooperations BANACOL and BANDECO also showed interest in the export of plantain. They buy the product directly from the associations of small producers. This offers them a guaranteed price and the marketing of the product.
At certain times in the year, when there is a shortage of plantains in Managua (Nicaragua), small traders of this vicinity come to The Atlantic Zone. The quality demands are the same, but of course they have high transportation costs because of the voyage to Nicaragua by truck. In general, the producers consider the presence of the "Nicas" to have a positive influence on the price for plantain (Bouma,1991).

1.4 Environmental requirements

Plantains are very demanding plants. It may be considered that even in their natural environment, namely the evergreen rainforest, they suffer from a water deficit in the dry season (Montcel,1987). But a shortage from water will not appear in The Atlantic Zone. Actually, the opposite endangers the plantain cultivation much more. Because of the high precipitation of about 4000 mm annual, flooding is a serious threat for cultivation.
With an average temperature of 24.4 °C annually, temperature will not be limiting for growth,

but of course it also plays a part in the development of plant parasites and diseases. Wind and light shortage problems will not appear in The Atlantic Zone.

Above all, soil structure is the most important issue when considering plantain cultivation. Plantains require a light, deep soil with few stones, which enables their roots to develop unhindered. Heavy soils with poor drainage, or those which compact easily, are not favourable. Silty-sandy and silty-clayey soils that are rich in organic matter are therefore ideal (Montcel,1987). As said before, areas liable to flooding are not very suitable for plantain cultivation. Drain systems under intensive cultivation are essential in the case of poorly draining soils.

The quantities of minerals in the soil are important, but the amount of organic matter in the soil is even more crucial. Since the removal of nutrients from the soil also depends on the chosen variety, fertilazition should only be practized after soil analysis (Montcel,1987). In general, these analysis are carried out by extension services and cooperations. They also advise the producers.

1.5 Pests and diseases

Plaintain, as well as banana, suffers from many pests and diseases. But there is a great diversity in sensibility to the different diseases within the Musa genus. Besides this genetic influence on sensibility, the environment also plays an important role. Both have a great influence on the severity of pests and diseases (Du Montcel,1987). It is important to distinguish pests, such as nematodes and insects, and pathogens, such as fungi, viruses and bacteria.

One of the most important pests is the banana weevil (*Cosmopolites sordidus*), laying her eggs in the upper part of the corm. The larvae bores tunnels in the corm, causing a weak corm through which the plant falls over or forms a small bunch. In The Atlantic Zone, the nematode *Radopholus similis* also appears. This is a root parasite, which causes lesions that are rapidly invaded by micro organisms. Besides these two pests, others appear, but they cause minor damage. For instance there are various insects, such as caterpillars that attack the leaves (Du Montcel,1987).

On many farms in The Atlantic Zone, rhizome rot appears, caused by the bacterium *Erwinia sp.*. On practically every farm, black Sigatoka appears, caused by the fungus *Mycosphaerella fijiensis*. The disease reduces the fotosynthetic area of the leaves. In chapter two this disease will be described more explicitly. Moko disease, caused by the bacterium *Pseudomonas solanacearum* also appears on some farms in the area (Du Montcel,1987).

2 Black Sigatoka

2.1 Introduction

Today, the most important production problem in plantain cultivation in the Atlantic Zone, is the control of the black Sigatoka disease.

Black Sigatoka was first observed in Central America in Vallee del Ulúa in Honduras in 1972. It existed there probably since 1969 on very small sites. From Honduras it spread slowly over the other countries in Central America. In October 1979 the disease reached Costa Rica. It was first noticed on a plantain plantation in San Carlos in the north of the country. It was probably imported on vegetative material transported by truck from Honduras, Nicaragua to Costa Rica. In September 1980 it was first detected in The Atlantic Zone on various farms near Guapíles. The disease spread with a velocity of 5 km/week eastwards. Before January 1981 the entire Atlantic Zone was invaded by the disease (González,1987).

Black Sigatoka is caused by the fungus *Mycosphaerella fijiensis Morelet*. Many investigators suggest that it is a possible mutant of *Mycosphaerella musicola* which causes the yellow Sigatoka disease in banana. *Mycosphaerella fijiensis* causes leafspots, resulting in premature death of large areas of the plants leaf surface. This reduction of photosynthetic activity leads to a loss of weight of the harvested bunches of fruit, and to the extension of the generative growing period of the plant. More important is the effect on the fruit quality. In the severest cases, the pulp of the fruit acquires an abnormal salmon yellow colour and may have an astringent taste. The fruits ripen prematurely on the standing crop, a few days after harvesting or during refrigerated transportation (Stover,1987).

2.2 Appearance of the disease

The first symptoms of the presence of *Mycosphaerella fijiensis* are superficial specks on the lower surface of the leaf. They are brown coloured and difficult to notice. They first appear on the left side of the leaf in the top. The small specks enlarge and form stripes, parallel to the veins. The next stage is the formation of spots. These spots are clearly visible on the leaf surface. They have a brown halo and a black heart. The spots coalesce and form bigger spots. The heart of the spots becomes grey, dries out and forms a hole in the leaf. If a large area is highly infected, the leaf turns black and dies, three or four weeks after the appearance of the first symptoms. In case of a severe infection, it is possible that only the first leaf is symptomless (González,1987).

The main source of inoculum is the ascospore. With an optimum temperature and precipitation, the ascospores can ripen within two weeks after appearance of the stripes. Both temperature and humidity play a very important role in the development of the disease. In dry and cold periods, with temperatures below 22°C, the development even decreases (González,1987). This appears in the dry months of December, January and February, on the other hand, an increase can be noticed in the hot, humid months from March to June.

2.3 Disease control methods

For a good disease control, it is necessary to have a good disease control program, consisting of both cultural practices and fungicide applications.

Cultural practices are precautions. For instance the removal of heavy infected leaves. This action reduces the amount of inoculum. It must be bore in mind that cutting green leaf area from the plant, reduces the photosynthetic capacity of the plant. Covering leaves, that have been removed, with fresh green leaves, also decreases the amount of inoculum. But for large farms, this action is too expensive, but it will absolutely benefit smaller farms. Improving drainage reduces the humidity and benefits the root system of the plant directly, resulting in a better health of the plant. The removal of weeds and a low plant density have the same effect; they lower the humidity. Reducing the amount of weeds also lowers the nutrient and water competition between weeds and plantain.

In general, fungicides are only applied when the fruits are produced for export. Adequate quantities are produced for the local market without spraying. Fungicides only have effect on the early stage of development of the fungus. Then, the fungus is most vulnerable (González,1987). Two kinds of fungicides are applied: protectant and systemic fungicides. The protectants, or contact fungicides, do not enter the leaf tissue, so these fungicides should be distributed uniformly on the leaf surface. These fungicides have a direct effect on the fungus. The mostly used protectant fungicides are the dithiocarbamates. The great advantage of the systemic fungicides is that they enter the leaftissue and can translocate to other plant parts. For instance, they can also be active in the root system. In the case of black Sigatoka the ability to penetrate the tissue is very useful, because it is also able to penetrate through the upper surface of the youngest unfurled leaves, where the pathogen is still in the early stages of development (Fullerton,1989).

Table 1. Most applied fungicides in plantain and banana

Type	Group	Name	Dosage (gr/ha)
protectant	dithiocarbamates	Dithane M45	1000
		Manzate M200	1000
		Vondozeb	1000
		Manzicarb	1000
	clorotalonil	Bravo 500	750
systemics	benzimidazoles	Benlate	150
	tridemorph	Calixin	300
	triazoles	Tilt	100
		Punch	100

Source: Romero,1987

Unfortunately, certain systemic fungicides appeared to cause resistance of the pathogen. This was first reported for benzamidazoles (benomil). The solution is the use of mixtures of systemic and protectant fungicides or two different systemic fungicides. Both reduce the ability of the pathogen to build up resistance. There are different opinions about the use of mixtures. Manufacturers suggest that the fungicides must be used alternately and not in mixtures. Banana producing companies, on the other hand, are testing mixtures with a view to improve costs and efficiency (Fullerton,1989). The cheapest fungicides for plantains are the protectant Mancozeb, and the systemics benzimidazoles and tridemorphs (Romero,1987).

The use of fungicides mixed with oil is meant to improve spreading and sticking of all fungicides. Besides, it has also an effect on the pathogen inside the leaf, especially in the youngest stage of development of the fungus. But care must be taken with oil mixtures, because of the phytotoxic effect of oil on the plant. This appears when the applied dosage is too high (Fullerton,1989).

2.4 Economical importance

The major effects of the fungus disease on production are the decrease in production, because of pre-mature ripening and the lower quality, and the higher production costs because of the fungicide application. The cheapest fungicides in plantain cultivation are Mancozeb in oil, benimidazoles and tridemorphs. Seven applications in 62 weeks is the average program, that means one aplication every 62 days.

The last years various improvements have been made to lower the costs of fungicide application. Farmers and cooperations started monitoring the epidemiology of the disease through an early warning system. It is based on weekly biological observations on the youngest leaves. The use of new fungicides, such as propiconazoles, a systemic fungicide, integrated with other systemic fungicides, which are much more effective in black Sigatoka control. Another improvement is the new low-volume application technique with good coverage and recovery to obtain maximum efficiency. Finally, the change from overhead irrigation, which washes off fungicides, to under-canopy irrigation, which reduces disease incidence and severity. Because, for spore germination, germtube growth and penetration a surface film of moisture is essential, and that is provided with overhead irrigation (Fullerton,1989).

Obviously, not only the farmer benefits from a better black Sigatoka control, but also the environment is served by reducing the amount of pesticides applied.

3 Methodology

3.1 The design of the investigation

Nine plantain producing farms have been selected in The Atlantic Zone. They differ in production system and disease management. The farms vary from traditional, low input, to intensive, high input systems. Eight farms were also part of the investigation of Oswaldo Torres on nematodes appearance in plantain farms. The ninth farm, Exparca was included in this investigation because of her high input cultivation system.

The farms are situated in different places in The Atlantic Zone. Seven farms are in the proximity of Estrada, between Siquirres and Limón. La Lucha is situated approximately twenty kilometers North East of Jimenez, and Exparca twenty kilometre North of Guapiles.

During nine weeks, each farm was visited four times. It was found unnecessary to visit all the farms every week, because the appearance of black Sigatoka does not show great fluctuations within one week. Therefore it seems sufficient to visit them every two weeks. To spread the work, the farms were divided into two groups (See table 3.1). Table 3.2, shows the time schedule.

Table 3.1 Division of farms in groups

I	II
La Lucha	Tiburcio
Dunn	Exparca
Baltazar	Villegas
La Minita	Gringo
Danielo	

The appearance of black Sigatoka was reported on each farm using the Stover scale (See chapter 3.2). During the visits, information was obtained about the production system and disease management used (See appendix I). On each farm, one field was selected with a homogenic and specific soil type. In this field, twelve plants were selected in four groups of three plants each. These four groups were on different sites of the field, so that a random interpretation

Table 3.2 Time table (weekly)

Week	1	2	3	4	5	6	7	8	9
Group I	x			x		x		x	
Group II			x		x		x		x
Data	4-5..........................29-6								

of the field could be made. The plants in the field chosen for observation all had about the same stage of development, they were all close to flowering, and had about the same height. The investigations took place between the 4[th] of May and the 22nd of July.

3.2 The Stover scale

The scales that many institutions use for the visual estimation of black Sigatoka severity, were originally designed for yellow Sigatoka. These days, two scales are commonly used for black Sigatoka investigations; the scale of Gauhl and the scale of Stover. Usually, the Gauhl scale is used in black Sigatoka forecasting systems. This scale is very suitable, because the speed of disease development is measured. This scale consists of five different levels, all in the early stage of development of the disease.

Stover (1984) designed a scale with six levels to estimate the intensity of the black Sigatoka disease on the leaf. His scale describes the appearance of the disease on the leaf, or, more specific, the rate of infected leaf area correlated to the development of the disease. In table 3.3 the different levels of the Stover scale are described (See appendix IV).

In the field, the most important problem appears with the estimation of stage one of the scale, because in many cases the plants are too high. Especially the youngest leaves, which are in the top of the plant, are very difficult to observe. Then, the difference between stage one and stage zero is even harder to see. But in the youngest leaves, the appearance of stage one is very important, because it indicates the speed of disease development in the Stover scale. Even when observing older, lower placed leaves, stage one is very difficult to observe. Most of the time, no problems arise with distinguishing the other levels of the Stover scale in the field.

Table 3.3 Stover scale for grade of infection for black Sigatoka

Grade of infection	Symptoms
0	Without symptoms
1	Stripes and less than 10 spots
2	till 5% infected leaf area
3	6% till 15% infected leaf area
4	16% till 33% infected leaf area
5	34% till 50% infected leaf area
6	more than 50% infected leaf area

Source: CORBANA

3.3 The field work

During the visits to the farms the following information was collected of each plant that was investigated, :

1 Number of leaves per plant (as an indication of the plant health)
2 Hoja Más Joven Infectado (H.M.J.E.); the youngest infected leaf
3 Hoja Más Joven Necrotico (H.M.J.N.); the youngest leaf with necrotic spots (as a indication of disease development)
4 The number of leaves of the plant with the different stages of the Stover scale

The youngest infected leaf, is the first leaf with stage one of the Stover scale. The youngest leaf with necrotic spots, is the youngest leaf with stage two or higher of the Stover scale. Necrotic spots or areas are visible.

To number the leaves, the following method was used: the last totally unfurled leaf is leaf number one. The other leaves are numbered by going downwards. The lowest leaf is the oldest and thus has the highest number.

The data were written down on a form that CORBANA also uses for black Sigatoka investigations in banana and plantain (See appendix III). The paper is designed for sampling 20 plants in four quarters of the field, but can of cause also be used for 12 plants in four quarters of three plants each. Afterwards, the average of the total number leaves per plant per farm, the youngest infected leaf per farm and the youngest leaf with necrotic spots per farm, could be calculated. With the numbers of leaves of the plant with the different stages of the Stover scale, the percentages per Stover scale stage could be calculated per farm, and with these percentages finally the "Promedio Ponderado Infección" or Mean Weight Infection (P.P.I.) value could be calculated (See appendix II).

The calculations were done for each farm once every two weeks and also over the entire period of investigation of eleven weeks. In this way, the development can be observed.

3.4 Comparing farms

As described before, after calculating the percentages of the different stages of the Stover scale, the P.P.I. value can be calculated. The P.P.I. value is a good way of comparing the disease severity of different farms. To calculate the P.P.I., formula 3.1 is used.

Formula 3.1 The calculation of the P.P.I.

P.P.I.= (0 x %leaves with stage 0) + (1 x %leaves with stage 1)
+ (2 x %leaves with stage 2) + ... + (6 x %leaves with stage 6)

Source: CORBANA

The lower the total rate of infection of the plant, the lower the P.P.I. value. The higher the total rate of infection, the higher the P.P.I. value. In general, the P.P.I. has a value between 0,5 and 2,0 (CORBANA).

A good indication for plant health is the total number of leaves per plant. The more leaves the plant has, the healthier it is, because it drops off sick and too old leaves.

Finally, the H.M.J.N. gives an indication of the development of the disease and the rate of development. The younger this leaf is, the severer the disease appears and the faster it will develop. The H.M.J.E. is not used in the investigation, because it is rather unreliable because of the difficulty of seeing the difference between stage zero and stage one of the Stover scale. Another reason is that it is usually only used in disease forecasting systems as an indicator of the appearance of stage one, and thus the beginning of disease development.

3.5 The interview

In a small interview with the farmers, information was gained about the fungicide applications, the plant density (plants/ha), the drainage, the weed control, the yield (kg/ha) and the leafcutting as a sanitary action. This information gives an indication of the farm and disease management.

The importance of weed control is to lower the effect that weeds have on the microclimatic humidity in the crop and the nutrient and water concurrence between the weeds and the crop. With an intensive weed control the influence of the weeds on the crop is low. Weed control can be either by herbicide application or by hand cutting with a manchetta. The use of herbicides may cause burning spots on the plant when the herbicide contacts the plant (Du Montcel, 1987). Weed control is described as the number of actions.

Drainage is an important issue, because of its influence on plant health and the micro climatic humidity. The root system of the plantain is very rapidly damaged by excess of water in the soil. Therefore a bad drainage directly influences the plant health (Du Montcel,1987). The drainage is valued as good or bad, depending on the experience of the farmer.

In many farms, the heavy infected leaves are cut as a form of field sanitation to lower the rate of disease development. Parts of leaves can also be cut of. In that way the green leaf area of the plant is less affected. Unfortunately, it is difficult to value this action, when comparing farms. It is only described whether the farmer cuts leaves or other parts, or not.

The application of fungicides is described as the number of times per year. It is not useful for the investigation to describe the fungicide used. When the farmers use fungicides, they all use about the same fungicides.

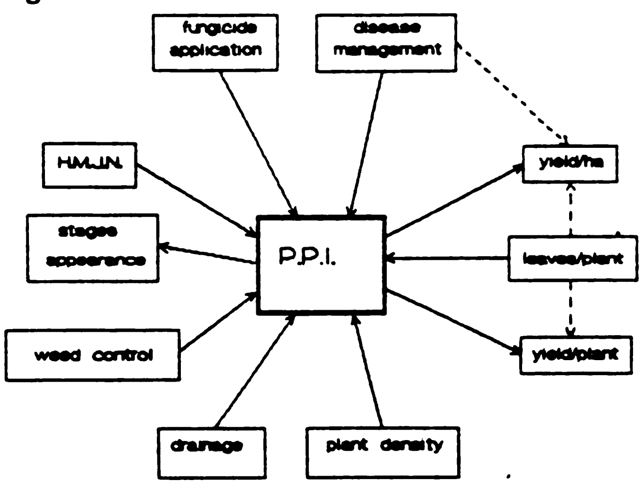
4 Conclusions & Discussions

4.1 Introduction

In this chapter, the major conclusions are drawn after using the "general linear models procedure" of the computer department of CATIE for statistic analysis. Some of the relations are visualized in graphs.

The most important relations drawn from the data, are described in the following paragraphs. Every subject is related to the P.P.I. value (See figure 4.1), but a few exceptions were made. In the statistic analysis all the entities were related to each other, so that relations were also found which were not directly interesting to the investigation on black Sigatoka appearance.

Figure 4.1 Items related to P.P.I.



Of three clear relations, the computer calculated the regression lines. With both statistical analysis and graphs, conclusions were drawn.

4.2 The relation between P.P.I. and disease management

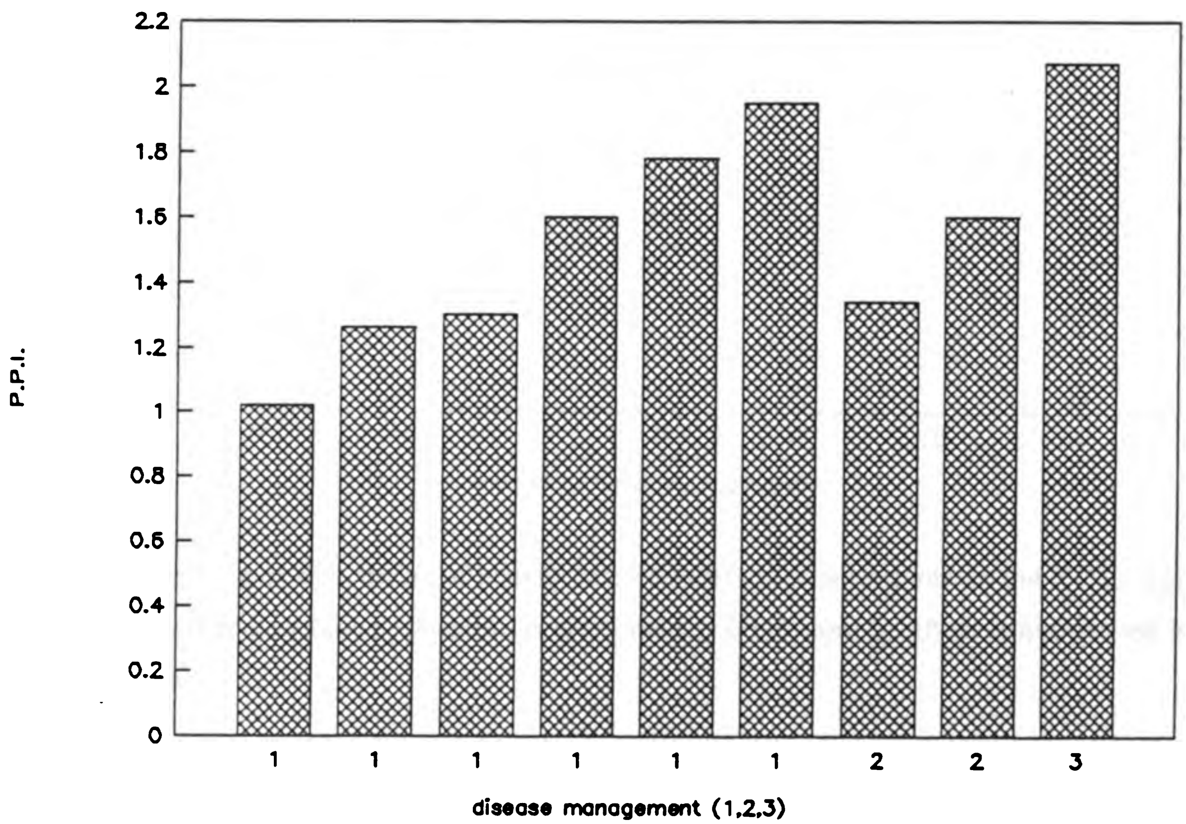
To compare the different systems of disease management with the P.P.I. value, three groups were created;

1. farms that both apply fungicides and cut heavily infected leaves (Exp., Balt, La Min.,Tib.,Dan.,Vill.)

2. farms that only cut heavily infected leaves or leaf areas, but do not apply fungicides (La Lucha,Dunn)
3. farms that neither apply fungicides nor cut heavily infected leaves or leaf areas (Gringo)

As can be seen in figure 4.2 and also can be concluded from the calculated correlation coefficient (0.44376) and probability coefficient(0.2315), it is not possible to indicate of a relation between disease management and P.P.I. to make this clearer, the relation between P.P.I. and fungicide application was also investigated.

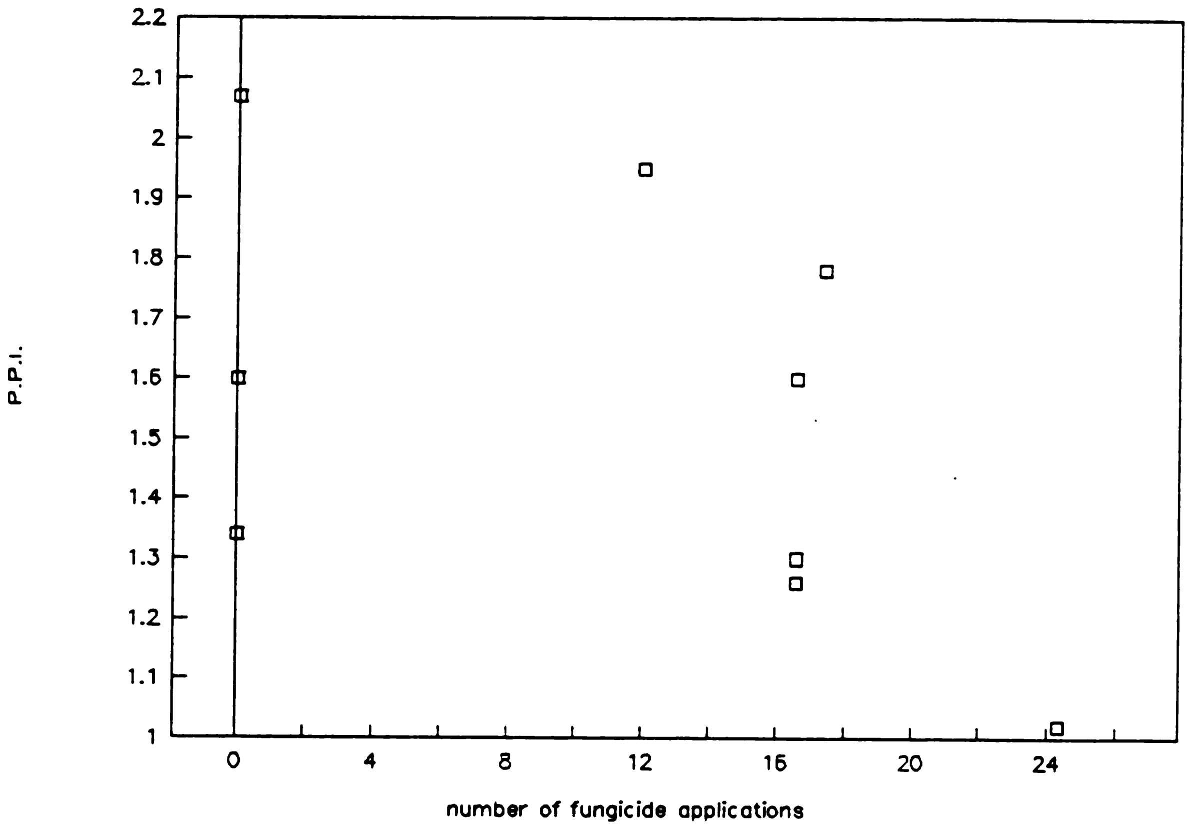
Figure 4.2 The relation between P.P.I. and disease management



4.3 The relation between fungicide application and P.P.I.

To describe the relation between P.P.I. and fungicide application, only the number of applications are mentioned (see chapter 3.5). Farms that don't apply fungicides have zero (0) applications of fungicides. The results of the statistic analysis (Corr. -0.46665, prob. 0.2054) and figure 4.3, show that it is not allowed to indicate any relation between the number of fungicide applications and disease appearance.

Figure 4.3 Relation between P.P.I. and fungicide application



Since leaf cutting or the cutting of heavily infected leaf areas always lowers the P.P.I., it can be doubted whether fungicide application is economically important. Its effect is not proved in this investigation.

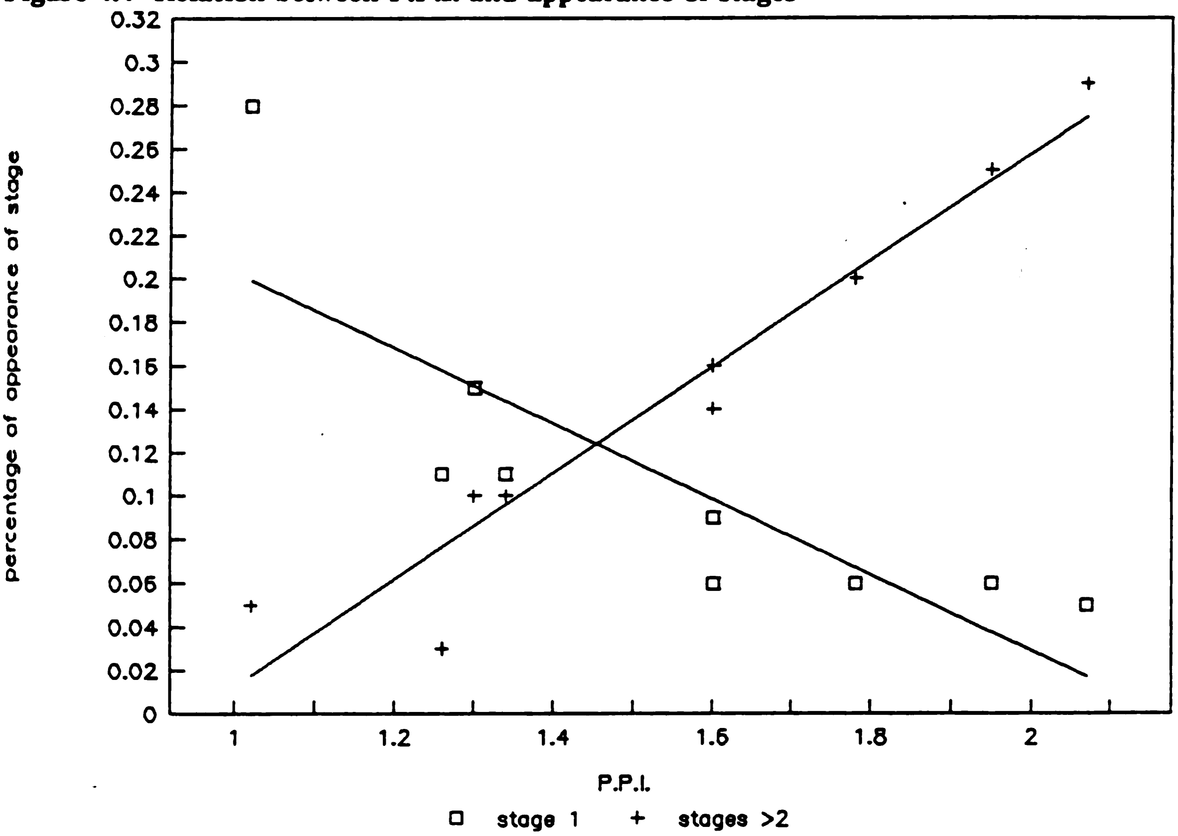
4.4 The relation between the appearance of stages and P.P.I.

The clearest relation that is found, is between the appearance of stage one, and the appearance of the stages three, four, five and six and the P.P.I. value. Both relations are confirmed by the correlation and the probability coefficients.

The strongest relation is found between the appearance of stage three, four, five and six and the P.P.I. (Corr. 0.96647, prob. 0.0001). This indicates that with a higher appearance of these stages the P.P.I. will also increase. This can be explained by the influence that these stages have on the formation of the P.P.I. (See formula 3.1).

A bit weaker is the relation between P.P.I. and the appearance of stage one (Corr. -0.82905, prob. 0.0057), which indicates the onset of disease development. Here the opposite appears. With a decreasing P.P.I., the percentage of stage one increases. This can also be explained by the impact that the appearance of stage one has on the formation of the P.P.I., since its influence is relatively low, compared to stages three, four, five and six of the Stover scale.

Figure 4.4 Relation between P.P.I. and appearance of stages



When it is taken in mind that a high appearance of the higher stages of the Stover scale, results in a higher disease pressure since in these stages high amounts of perithecia are formed in the necrotic lesions on the leaf and these stages usually appear under favourable conditions for the fungus, the presence of the stages thus indicates a higher velocity of disease development. Because the amount of inoculum will be higher and the conditions better.

On the other hand, a high presence of stage one of the Stover scale indicates a reduced rate of disease development, directly resulting in a lower disease pressure and thus a lower P.P.I. value. For this reason, a close relation can be indicated between the appearance of stage one and the appearance of stages three, through six. This relation is made visual by the regression lines in figure 4.4.

4.5 The relation between H.M.J.N. and P.P.I.

Figure 4.5 shows very clearly, that there is a strong relation, described by the regression line, between the P.P.I. and the youngest leaf with necrotic spots. This relation can be proved by the statistical analysis (Corr.-0.75576, prob. 0.0185). A proper explanation might be the following: the younger this leaf is, the more time the disease has to develop severely. A severe disease appearance thus leads to a higher P.P.I., because of the higher presence of the higher stages of the Stover scale.

4.6 The relation between disease management and yield

Disease management appears to be related to yield, both per plant (Corr. -0.90510, prob. 0.0018) and per hectare (Corr. -0.80253, prob. 0.0165). Although disease management does not appear to have effect on the P.P.I., it appears to be strongly related to yield.

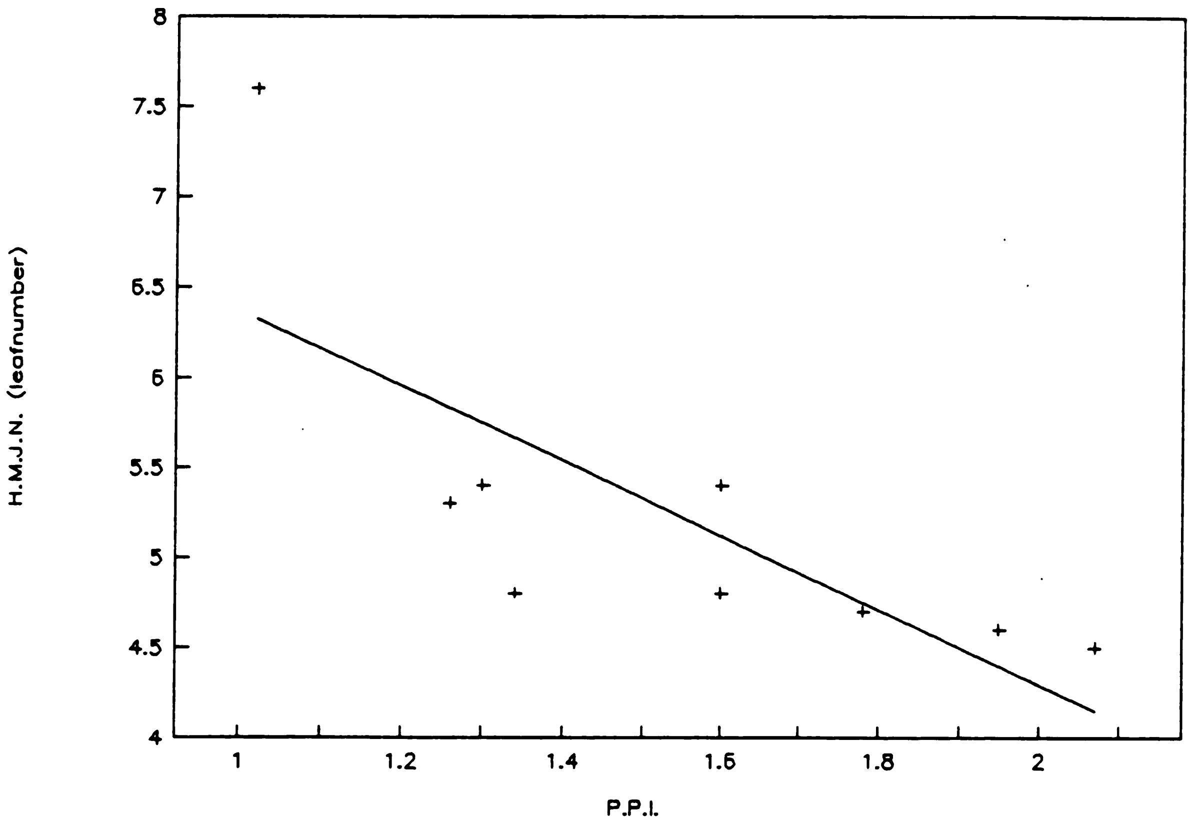
4.7 The relation between P.P.I. and number of leaves per plant

Although plant health has an impact on the number of leaves per plant, a good relation between P.P.I. and the number of leaves per plant was not found. A possible explanation is that a reduced number of leaves has an effect on the P.P.I., and also on plant health. For instance when infected leaves are removed, it reduces the number of leaves, but also the P.P.I. value. When leaves are not removed, the disease will be more severely present, thus resulting in a reduced plant health and also a lower number of leaves, and a high P.P.I..

4.8 The other relations with the P.P.I.

Between the other items drainage, weed control, plant density and yield, and P.P.I., no relations were found. This was to be expected because of the limited amount of available information available. For drainage and weed control, no good assessment method could be used, and data about plant density and yield are also rather unreliable. Other, external relations are excluded, and not further investigated.

Figure 4.5 The relation between P.P.I. and H.M.J.N.



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Appendices

BIBLIOTECA
Centro Interamericano de Documentacion e Información Agricola
IICA - CIDIA

1 farm: Exparca
2 farmer: Fabio Velásquez Mejías
3 group: 2

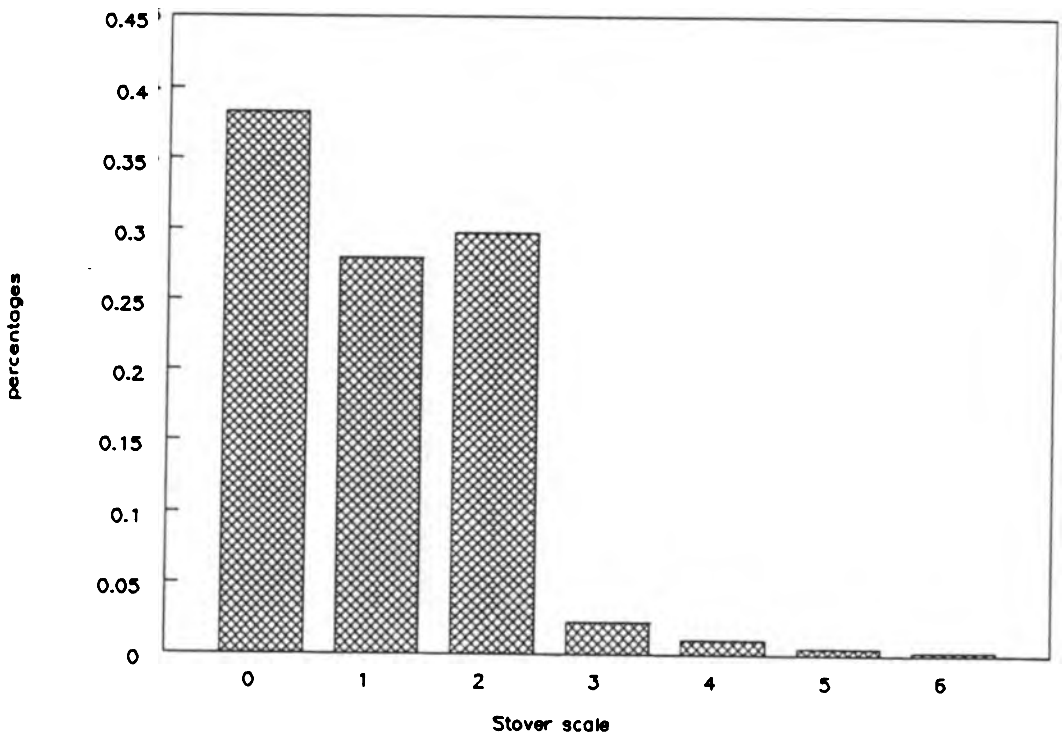
4 farm management system:	-plant density: 1860 plants/ha -drainage: good -weed control: yes, only herbicides
5 disease control:	-fungicide application: 24,3 times a year -leaf cutting (sanitary): 52 times a year
6 disease appearance:	-P.P.I.-average: 1,02 -Stover scale percentages: see figure I.1 -average H.M.J.N.: 7,6

7 plant health: average amount of leaves at flowering: 11,4 leaves/plant

8 production estimation:	-yield per hectare: not yet known, plantation is not yet in production (13-7-'92) -yield per plant: do.

9 remarks: also uses oil against black Sigatoka

Figure I.1 Exparca black Sigatoka distribution



1 farm: Baltazar
2 farmer: Baltazar Jimenez
3 group: 1

4 farm management system: -plant density: 1111 plants/ha
-drainage: unknown
-weed control: herbicides and hand cutting

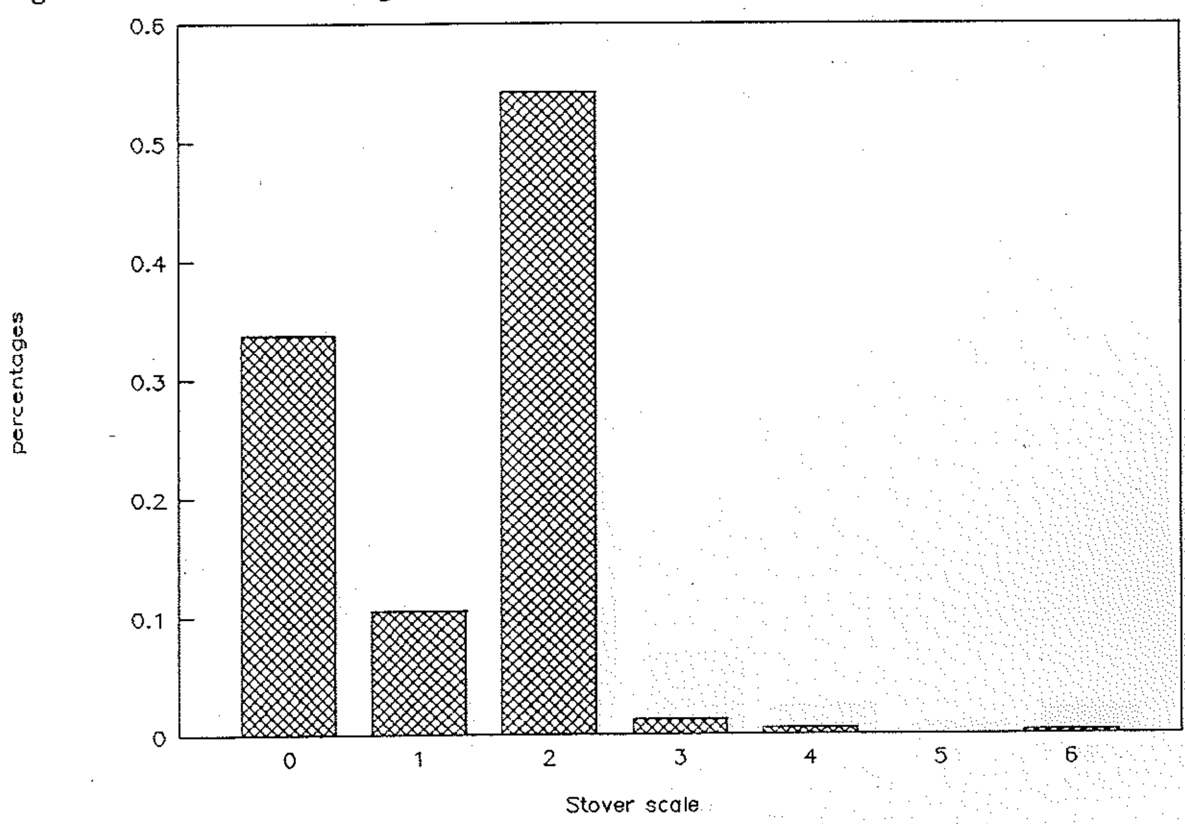
5 disease control: -fungicide application: 16,6 times a year
-leaf cutting (sanitary): yes

6 disease appearance: -P.P.I.-average: 1,26
-Stover scale percentages: see figure I.2
-average H.M.J.N.: 5,3

7 plant health: average amount of leaves at flowering: 12,2 leaves/plant

8 production estimation: -yield per hectare: 8.666 kg/ha/year
-yield per plant: 7,8 kg/plant/year

Figure I.2 Baltazar black Sigatoka distribution



1 farm: La Minita
2 farmer: Juan Salazar Sanchez
3 group: 1

4 farm management system: -plant density: 1811 plants/ha.
-drainage: good
-weed control: herbicides and hand cutting

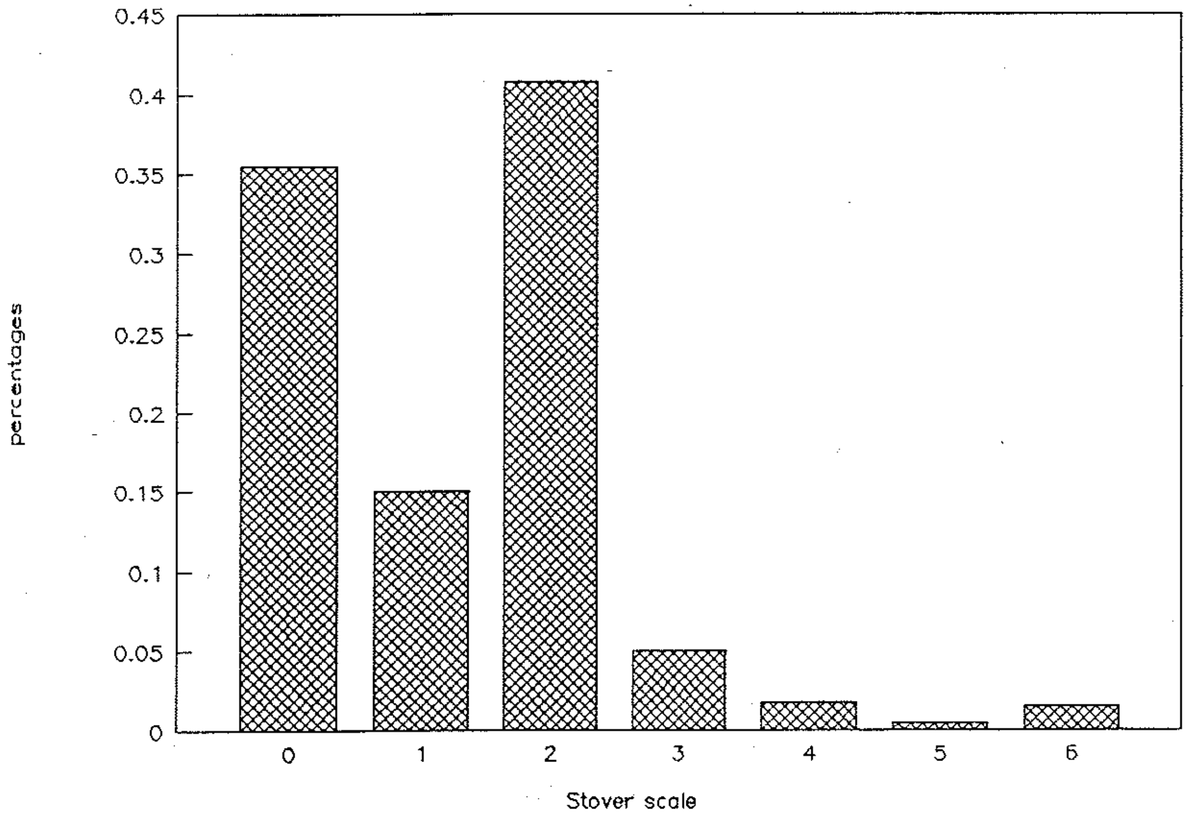
5 disease control: -fungicide application: 16,6 times a year
-leaf cutting (sanitary): yes

6 disease appearance: -P.P.I.-average: 1,30
-Stover scale percentages: see figure I.3
-average H.M.J.N.: 5,4

7 plant health: average amount of leaves at flowering: 9,3 leaves/plant

8 production estimation: -yield per hectare: 14.079 kg/ha/year
-yield per plant: 7,8 kg/plant/year

Figure I.3 La Minita black Sigatoka distribution



1 farm: La Lucha
2 farmer: Carlos Alberto P.
3 group: 1

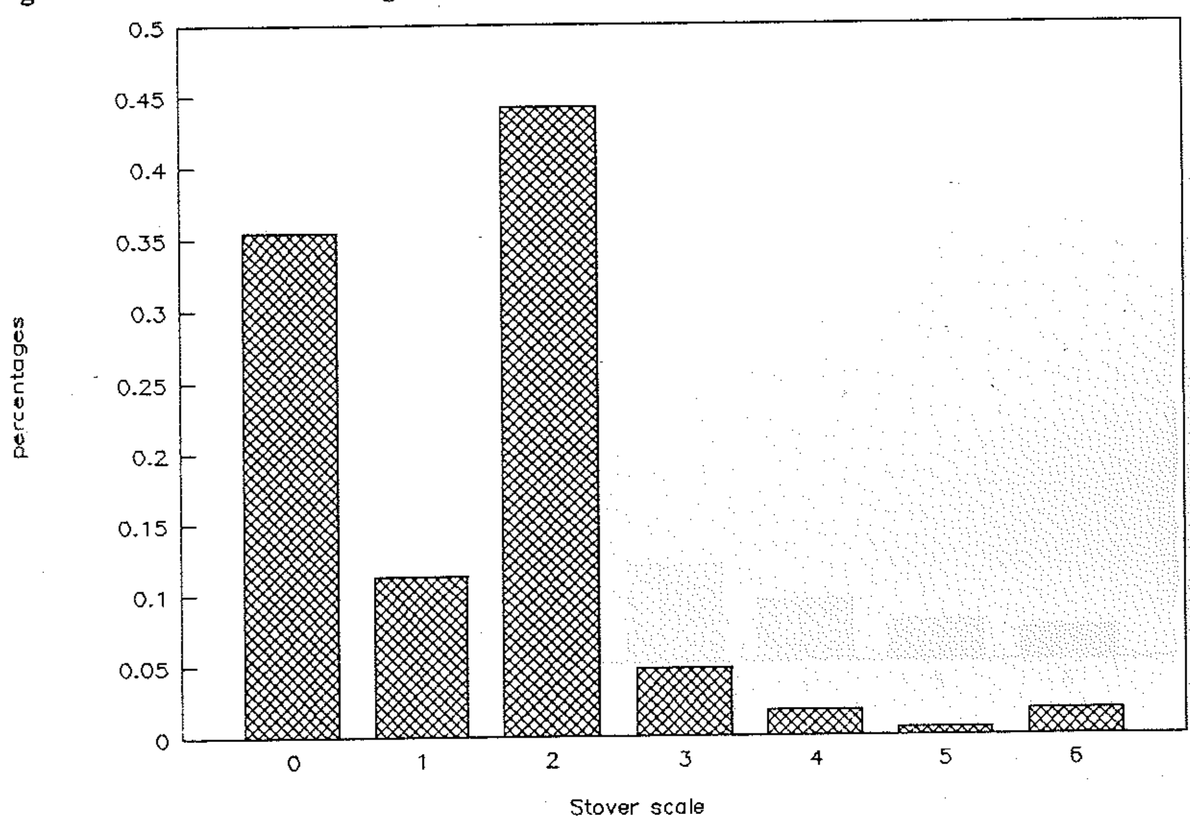
4 farm management system:	-plant density: 1111 plants/ha -drainage: problems -weed control: herbicides and hand cutting
5 disease control:	-fungicide application: no -leaf cutting (sanitary): 24,3 times a year
6 disease appearance:	-P.P.I.-average: 1,34 -Stover scale percentages: see figure I.4 -average H.M.J.N.: 4,8

7 plant health: average amount of leaves at flowering: 8,8 leaves/plant

8 production estimation:	-yield per hectare: 8.034 kg/ha/year -yield per plant: 7,2 kg/plant/year

9 remarks: no other large banana/plantain cultivation in the area; isolated

Figure I.4 La Lucha black Sigatoka distribution



1 farm: Tiburcio
2 farmer: Tiburcio Taurino
3 group: 2

4 farm management system: -plant density: 1333 plants/ha.
-drainage: unknown
-weed control: with herbicides and hand cutting

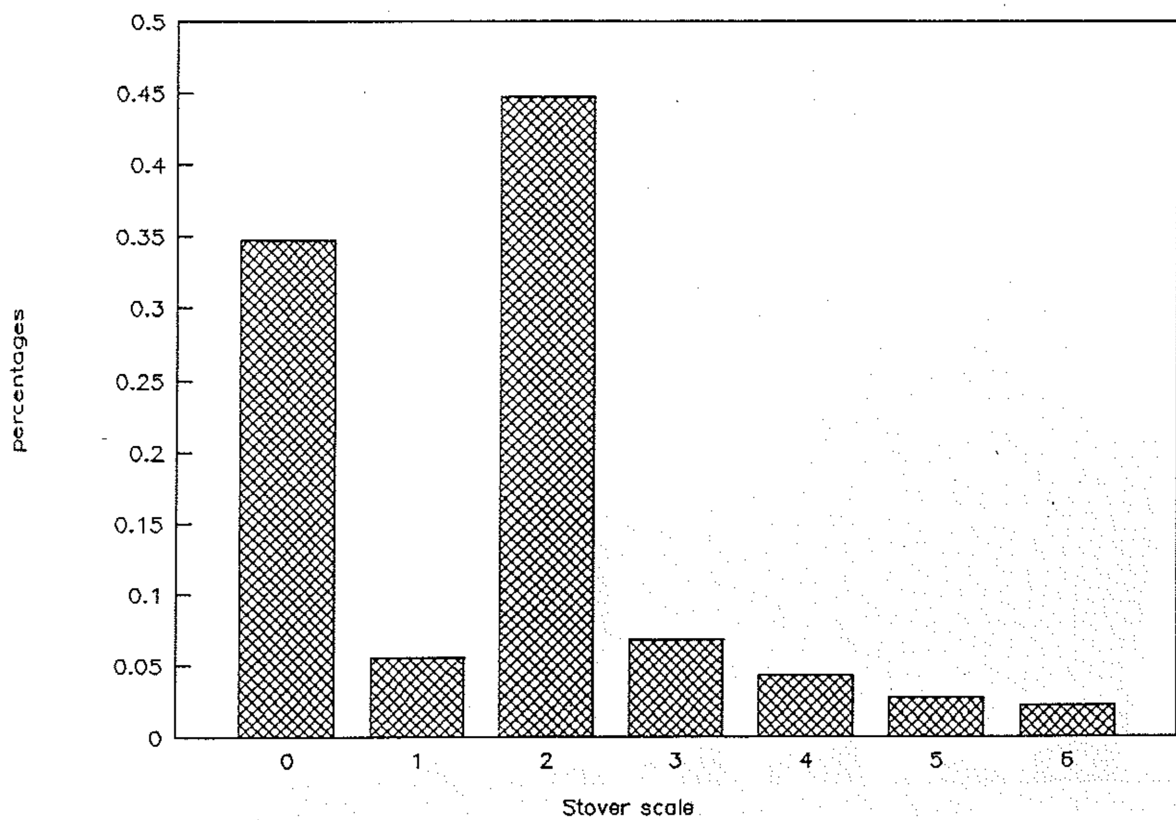
5 disease control: -fungicide application: 2 times a year
-leaf cutting (sanitary): yes

6 disease appearance: -P.P.I.-average: 1,60
-Stover scale percentages: see figure I.5
-average H.M.J.N.: 4,8

7 plant health: average amount of leaves at flowering: 9,9 leaves/plant

8 production estimation: -yield per hectare: 10.843 kg/ha/year
-yield per plant: 8,1 kg/plant/year

Figure I.5 Tiburcio black Sigatoka distribution



1 farm: Dunn
2 farmer: Jorge Dunn Trith
3 group: 1

4 farm management system: -plant density: 1200 plants\ha.
-drainage: problems
-weed control: herbicide/hand cutting; alternating

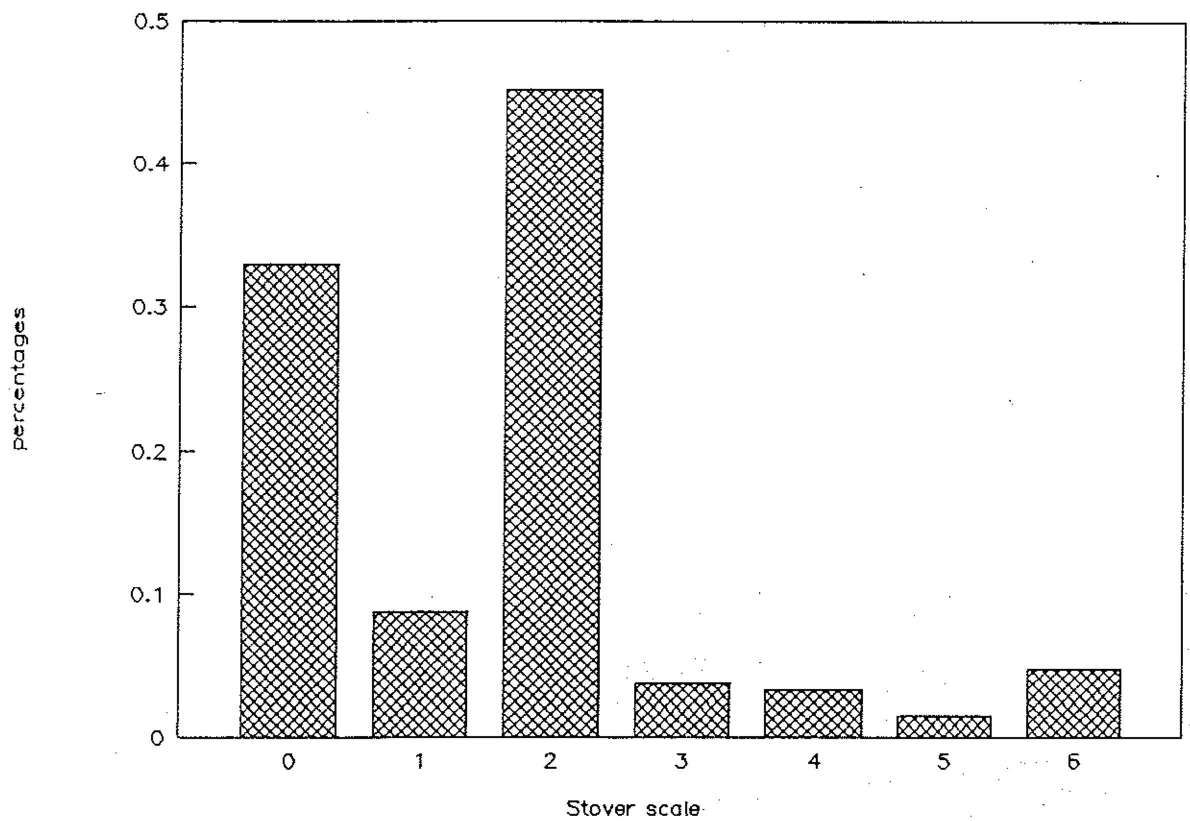
5 disease control system: -fungicide application: no
-leaf cutting (sanitary): yes

6 disease appearance: -P.P.I.-average: 1,60
-Stover scale percentages: see figure I.6
-average H.M.J.N.: 5,4

7 plant health: average amount of leaves at flowering: 11,3 leaves/plant

8 production estimation: -yield per hectare: 6.658 kg/ha/year
-yield per plant: 5,5 kg/plant/year

Figure I.6 Dunn black Sigatoka distribution



1 farm: Danielo
2 farmer: Danielo Foster Kerr
3 group: 1

4 farm management system: -plant density: 1500 plants/ha
-drainage: good
-weed control: no herbicides, only with knive

5 disease control: -fungicide application: 17,4 times a year
-leaf cutting (sanitary): 24,3 times a year

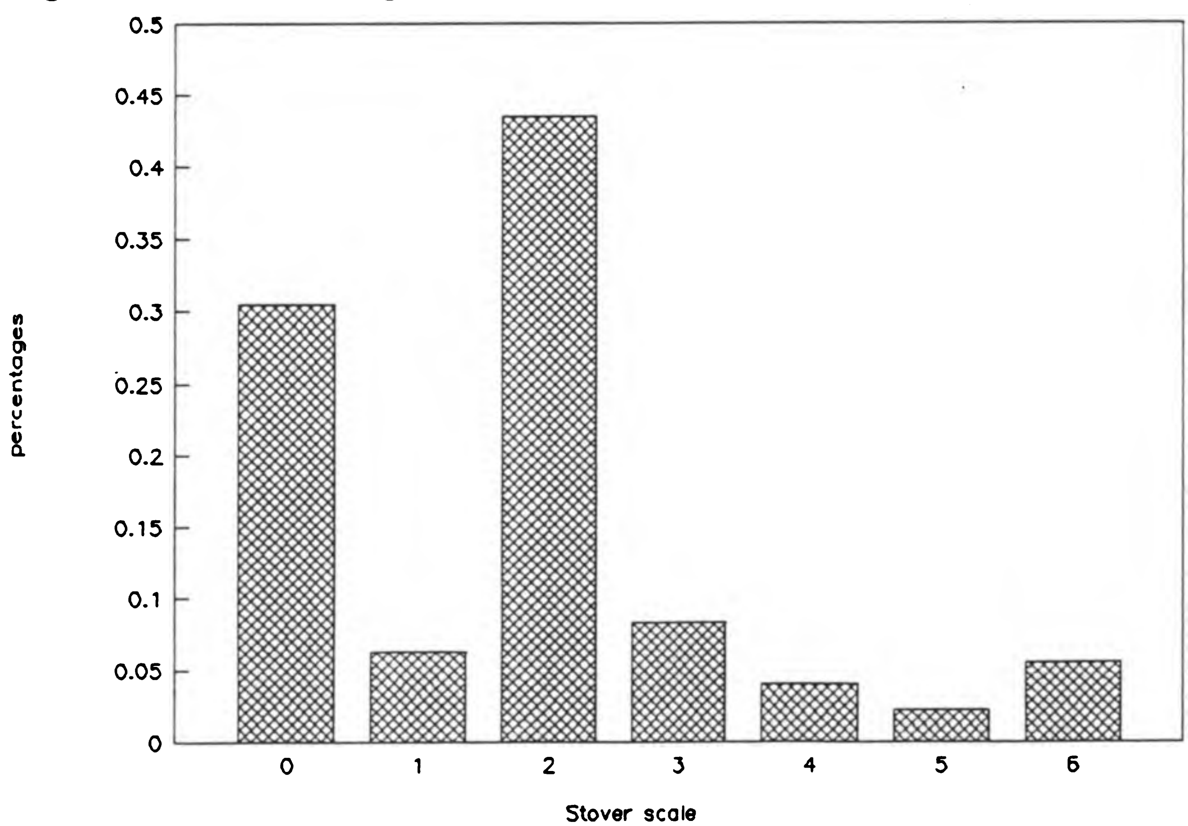
6 disease appearance: -P.P.I.-average: 1,78
-Stover scale percentages: see figure I.7
-average H.M.J.N.: 4,7

7 plant health: average amount of leaves at flowering: 10,3 leaves/plant

8 production estimation: -yield per hectare: 14.360 kg/ha/year
-yield per plant: 9,6 kg/plant/year

9 remarks: high plants

Figure I.7 Danielo black Sigatoka distribution



exparca	H/P	HMJE	HMJN	0	1	2	3	4	5	6	check	P.P.I.:
date												
21-5	11	5.3	8.3	0.39	0.36	0.2	0.03	0	0.02	0	1	0.95
05-6	11.5	5	7.9	0.37	0.33	0.26	0.02	0.01	0	0.01	1	1.01
18-6	11.7	5.3	7.2	0.37	0.25	0.34	0.01	0.02	0	0	0.99	1.04
02-7	11.2	5.4	7.1	0.4	0.18	0.39	0.03	0.01	0	0	1.01	1.09
											0	0
											0	0
											0	0
average:	11.35	5.25	7.625	0.3825	0.28	0.2975	0.0225	0.01	0.005	0.0025		

P.P.I.-average: 1.0225

Baltazar	H/P	HMJE	HMJN	0	1	2	3	4	5	6	check:	P.P.I.:
date:												
06-5	12.9	3.7	5.8	0.25	0.18	0.57	0	0	0	0	1	1.32
27-5	12.8	5.3	5.3	0.4	0.04	0.55	0.01	0.01	0	0	1.01	1.21
10-6	11.3	4.5	4.8	0.33	0.1	0.55	0.02	0.01	0	0	1.01	1.3
24-6	11.6	5.1	5.2	0.37	0.1	0.5	0.02	0	0	0.01	1	1.22
											0	0
											0	0
average:	12.15	4.65	5.275	0.3375	0.105	0.5425	0.0125	0.005	0	0.0025		

P.P.I.-average: 1.2625

La Minita	H/P	HJJE	HMJN	0	1	2	3	4	5	6	check:	P.P.I.:
date:												
06-5	9	3	5.1	0.26	0.28	0.39	0.06	0.01	0	0	1	1.28
27-5	9.4	4.5	5.7	0.38	0.15	0.36	0.04	0.01	0.01	0.05	1	1.38
10-6	9.3	4.4	4.9	0.37	0.06	0.45	0.06	0.04	0.01	0.01	1	1.41
24-6	9.5	4.9	5.8	0.41	0.11	0.43	0.04	0.01	0	0	1	1.13
											0	0
average:	9.3	4.2	5.375	0.355	0.15	0.4075	0.05	0.0175	0.005	0.015		

Janielo	H/P (av)	HMJE (av)	HMJN (av)	0	1	2	3	4	5	6	check:	P.P.I.:
3ate:												
37-5	11.3	5	5.9	0.36	0.08	0.27	0.15	0.09	0.02	0.05	1.02	1.83
28-5	9.3	3.4	4.3	0.26	0.14	0.5	0.06	0	0.03	0.01	1	1.53
10-6	10.1	3.4	3.4	0.25	0	0.6	0.03	0.02	0.02	0.08	1	1.95
24-6	10.3	4.7	5	0.35	0.03	0.37	0.09	0.05	0.02	0.08	0.99	1.82
											0	0
											0	0
Dverage:	10.25	4.125	4.65	0.305	0.0625	0.435	0.0825	0.04	0.0225	0.055		

P.P.I.-average: 1.7825

villegas	H/P	HMJE	HMJN	0	1	2	3	4	5	6	check	P.P.I.:
date												
21-5	9.8	4.6	5	0.38	0.07	0.35	0.03	0.03	0.03	0.1	0.99	1.73
03-6	9.5	3.3	3.6	0.25	0.06	0.57	0.04	0	0.02	0.1	1.04	2.02
18-6	9.7	4.3	4.6	0.34	0.03	0.41	0.07	0.05	0.03	0.05	0.98	1.71
02-7	9.5	4.3	5.2	0.35	0.09	0.18	0.08	0.07	0.07	0.17	1.01	2.34
											0	0
											0	0
											0	0
average:	9.625	4.125	4.6	0.33	0.0625	0.3775	0.055	0.0375	0.0375	0.105	1.005	

P.P.I.-average: 1.95

gringo	H/P	HMJE	HMJE	0	1	2	3	4	5	6	check	P.P.I.:
date												
20-5	8.8	4.8	5.1	0.46	0.05	0.31	0.03	0.01	0	0.14	1	1.64
03-6	8.8	3.1	3.1	0.24	0	0.55	0.08	0.06	0.02	0.06	1.01	2.04
18-6	8.7	4.4	4.8	0.39	0.05	0.12	0.1	0.09	0.11	0.15	1.01	2.4
02-7	7.3	4	4.8	0.41	0.1	0.19	0	0.01	0.01	0.27	0.99	2.19
											0	0
											0	0
											0	0
average:	8.4	4.075	4.45	0.375	0.05	0.2925	0.0525	0.0425	0.035	0.155		

P.P.I.-average: 2.0675

La Lucha	H/P	HMJE	HMJN	0	1	2	3	4	5	6	check:	P.P.I.:
date:												
07-5	7.7	3.6	5.4	0.34	0.27	0.39	0	0	0	0	1	1.05
28-5	9.2	3.4	3.8	0.28	0.06	0.59	0.06	0	0	0	0.99	1.42
10-6	10.3	4.2	4.7	0.31	0.05	0.39	0.1	0.06	0.02	0.07	1	1.89
24-6	8	4.9	5.3	0.49	0.07	0.4	0.03	0.01	0	0	1	1
											0	0
											0	0
											0	0
average:	8.8	4.025	4.8	0.355	0.1125	0.4425	0.0475	0.0175	0.005	0.0175		
P.P.I.-average:		1.34										

Tiburcio	H/P	HMJE	HMJN	0	1	2	3	4	5	6	check	P.P.I.:
date												
21-5	10.3	4.7	5.3	0.43	0.07	0.38	0.04	0.07	0	0.02	1.01	1.35
03-6	9.8	3.8	3.8	0.28	0	0.62	0.02	0.03	0.03	0.03	1.01	1.75
18-6	9.5	4.1	4.3	0.32	0.04	0.48	0.08	0.04	0.04	0.01	1.01	1.66
02-7	9.8	4.4	5.6	0.36	0.11	0.31	0.13	0.03	0.04	0.03	1.01	1.62
											0	0
											0	0
											0	0
average:	9.85	4.25	4.75	0.3475	0.055	0.4475	0.0675	0.0425	0.0275	0.0225		
P.P.I.-average:		1.595										

Dunn	H/P	HMJE	HMJN	0	1	2	3	4	5	6	check:	P.P.I.:
date:												
06-5	12.9	3.7	5.8	0.25	0.18	0.57	0	0	0	0	1	1.32
28-5	10.1	4.5	5.2	0.36	0.11	0.45	0.02	0	0.03	0.03	1	1.4
10-6	10.5	4.5	4.6	0.34	0.01	0.51	0.02	0.06	0.02	0.04	1	1.67
24-6	11.5	5.3	5.8	0.37	0.05	0.28	0.11	0.07	0.01	0.12	1.01	1.99
											0	0
											0	0
											0	0
average:	11.25	4.5	5.35	0.33	0.0875	0.4525	0.0375	0.0325	0.015	0.0475		
P.P.I.-average:		1.595										

EVALUACION DE LA SIGATOKA NEGRA
PLANTAS PROXIMAS A PARIR

FINCA: ______________ SEMANA: ______________

TRATAMIENTO: __________ REPETICION: __________

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	H/P	HMJE	HMJN	0	1	2	3	4	5	6
1																									
2																									
3																									
4																									
5																									
														TOTAL											
														PROM.											

TRATAMIENTO: __________ REPETICION: __________

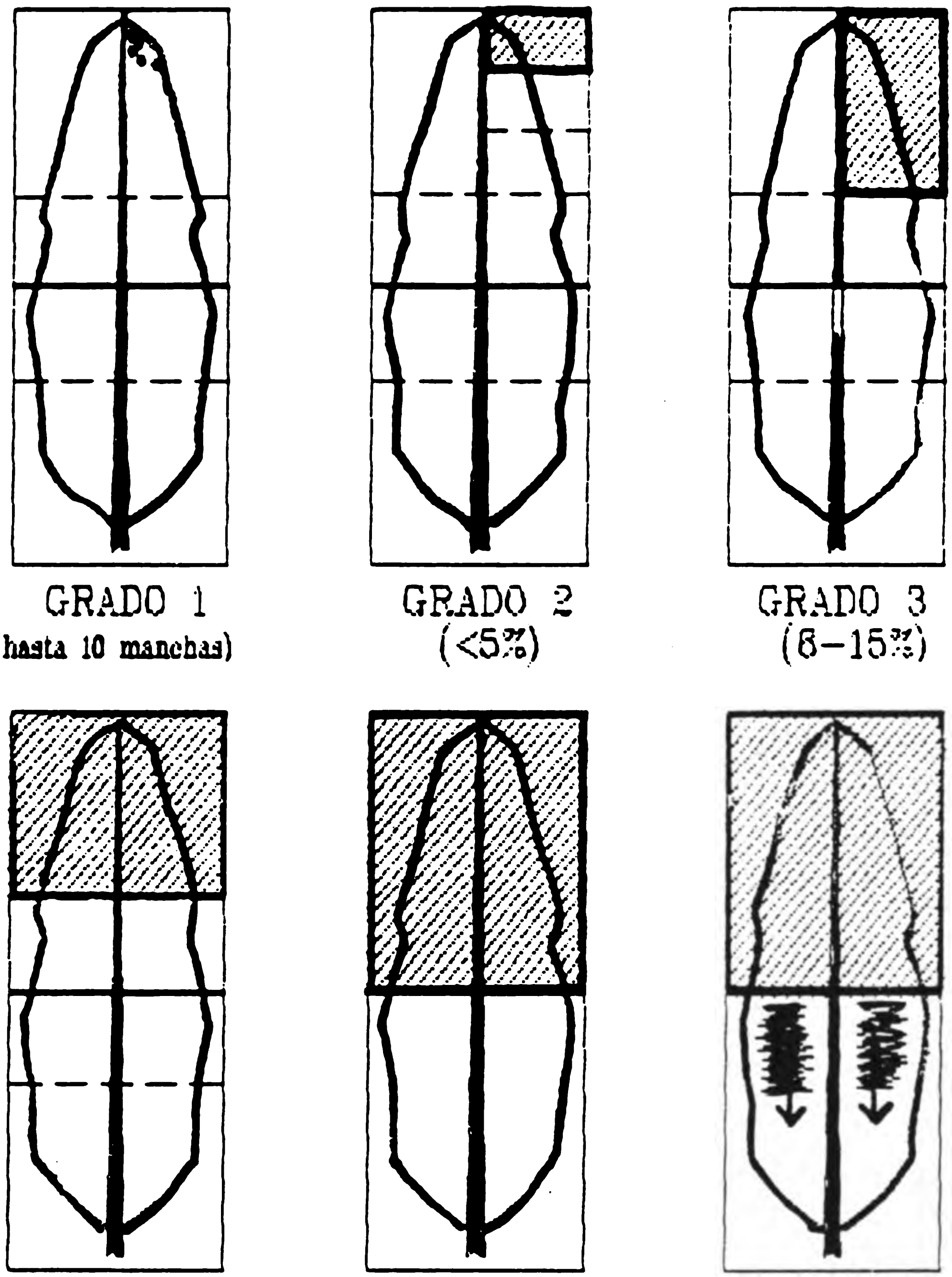
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	H/P	HMJE	HMJN	0	1	2	3	4	5	6
1																									
2																									
3																									
4																									
5																									
														TOTAL											
														PROM.											

TRATAMIENTO: __________ REPETICION: __________

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	H/P	HMJE	HMJN	0	1	2	3	4	5	6
1																									
2																									
3																									
4																									
5																									
														TOTAL											
														PROM.											

TRATAMIENTO: __________ REPETICION: __________

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	H/P	HMJE	HMJN	0	1	2	3	4	5	6
1																									
2																									
3																									
4																									
5																									
														TOTAL											
														PROM.											



GRADO 1 (hasta 10 manchas) | GRADO 2 (<5%) | GRADO 3 (6–15%)

GRADO 4 (16–33%) | GRADO 5 (34–50%) | GRADO 6 (>50%)

FIGURA 2: Escala de Stover modificada por Gauhl (1984) para la evaluación de incidencia a la Sigatoka Negra.

dibujo Ing. E. Soto
CORBANA

CORBANA S.A.
FITOPATOLOGIA

MES: ENERO **AÑO:** 1992

	Hum. Relativa			Temperatura			Lluvia - mm		Evaporac.- mm	
	Prom	Max.	Min.	Prom	Max.	Min.	Diaria	Acum.	Diaria	Acum.
1	86	97	58	22.9	28	18			2.5	2.5
2	88	97	62	23.0	29	19	7.0	7.0	1.0	3.5
3	87	97	61	23.7	28	21	6.5	13.5	2.5	6.0
4	87	97	65	23.7	27	21				
5	86	97	60	23.5	28	20	6.5	20.0	3.8	9.8
6	87	97	68	23.8	27	21	0.0	20.0	1.8	11.6
7	87	97	65	23.4	27	20	0.0	20.0	2.9	14.5
8	82	96	60	24.0	27	21	0.0	20.0	3.4	17.9
9	95	97	90	24.7	29	22	0.4	20.4	4.3	22.2
10	79	97	50	24.1	30	18	0.0	20.4	5.6	27.8
11	82	96	55	22.7	29	18				
12	84	97	55	23.8	29	19	6.0	26.4	1.0	28.8
13	93	98	80	23.5	26	22	6.3	32.7	1.6	30.4
14	89	97	72	23.5	27	20	0.0	32.7	2.7	33.1
15	84	97	55	23.5	28	19	3.5	36.2	1.4	34.5
16	89	98	70	22.7	25	20	6.0	42.2	4.5	39.0
17	79	98	47	23.7	29	20	0.0	42.2	5.0	44.0
18	82	97	55	24.3	29	19				
19	90	98	70	23.8	27	20	16.2	58.4	2.3	46.3
20	87	97	65	23.2	28	19	0.5	58.9	1.5	47.8
21	89	97	75	22.8	25	20	9.8	68.7	2.7	50.5
22	86	97	65	25.1	29	22	7.4	76.1	1.6	52.1
23	89	97	71	25.1	28	23	0.0	76.1	3.0	55.1
24	85	96	55	25.8	31	22	8.5	84.6	7.0	62.1
25	83	97	60	24.7	29	21				
26	80	97	55	24.2	29	19	0.0	84.6	3.0	65.1
27	79	97	50	24.5	30	20	0.0	84.6	3.0	68.1
28	84	97	60	23.4	28	19	14.4	99.0	1.8	69.9
29	87	97	55	23.5	28	21	3.0	102.0	2.3	72.2
30	85	98	63	23.9	28	20	1.9	103.9	2.4	74.6
31	83	97	58	23.7	27	22	1.0	104.9	5.3	79.9

x Diario: 86	x Diario: 23.8	Tot: 104.9	Tot: 79.9
x Máxima: 97	x Máxima: 28.0	x Diario:	x Diario:
x Mínima: 62	x Mínima: 20.2	3.3	2.5

LOCALIDAD: 28 MILLAS.

* Incluye el Sábado y Domingo.

CORBANA S.A.
FITOPATOLOGIA

MES: FEBRERO AÑO: 1992

	Hum. Relativa			Temperatura			Lluvia - mm		Evaporac.- mm	
	Prom	Max.	Min.	Prom	Max.	Min.	Diaria	Acum.	Diaria	Acum.
1	81.0	96	52	24.5	29	21				
2	87.0	98	60	23.1	27	20	9.6*	9.6*	4.5*	4.5*
3	78.0	97	50	24.0	29	19	0.0	9.6	3.9	8.4
4	79.0	97	50	25.2	30	21	0.0	9.6	3.7	12.1
5	79.0	97	50	25.6	30	21	0.0	9.6	2.5	14.6
6	80.0	98	49	26.3	31	22	0.5	10.1	3.9	18.5
7	90.0	97	68	24.8	28	23	6.7	16.8	6.1	24.6
8	86.0	97	60	25.2	29	23				
9	84.0	97	51	26.0	31	23	0.5*	17.3*	2.3*	26.9*
10	88.0	96	60	25.7	30	23	10.6	27.9	2.6	29.5
11	84.0	98	60	24.7	29	21	0.0	27.9	4.1	33.6
12	83.0	98	54	24.6	29	20	5.3	33.2	4.4	38.0
13	84.0	99	55	24.8	30	20	0.0	33.2	5.3	43.3
14	79.0	97	50	24.0	30	18	0.0	33.2	9.3	52.6
15	77.0	98	50	23.9	30	19				
16	82.0	98	54	24.9	30	19	3.4*	36.6*	5.0*	57.6*
17	86.0	98	62	24.6	29	21	5.3	41.9	1.1	58.7
18	94.0	98	80	23.8	27	21	23.0	64.9	1.2	59.9
19	95.0	98	82	23.3	26	22	22.5	87.4	2.9	62.8
20	98.0	98	98	21.0	22	20	0.1	87.5	3.9	66.7
21							6.4	93.9	4.9	71.6
22										
23							4.3*	98.2*	4.6*	76.2
24							0.0	98.2	3.0	79.2
25							0.0	98.2	4.2	83.4
26	77.0	98	50	26.8	31	22	0.0	98.2	3.0	86.4
27	86.0	97	60	25.0	30	21	9.0	107.2	3.6	90.0
28	86.0	97	55	24.8	29	21	0.9	108.1	5.2	95.2
29	82.0	97	54	24.3	30	19				
30										
31										

x Diario: 84.3	x Diario: 24.6	Tot: 108.1	Tot: 95.2
x Máxima: 97.5	x Máxima: 29.0	x Diario:	x Diario:
x Mínima: 58.9	x Mínima: 20.8	3.86	3.17

LOCALIDAD: 28.MILLAS

* INCLLUYE EL DIA ANTERIOR.

CORBANA S.A.
FITOPATOLOGIA

MES: MARZO **AÑO:** 1992

	Hum. Relativa			Temperatura			Lluvia - mm		Evaporac.- mm	
	Prom	Max.	Min.	Prom	Max.	Min.	Diaria	Acum.	Diaria	Acum.
1	95	97	85	23.2	24	22	17.0*	17.0	1.1*	1.1
2	94	97	80	23.5	26	23	70.5	87.5	2.9	4.0
3	87	98	65	24.3	28	21	1.7	89.2	3.8	7.8
4	82	97	53	24.6	30	21	0.0	89.2	3.8	11.6
5	84	97	57	24.4	29	20	2.3	91.5	6.8	18.4
6	85	97	60	25.3	30	23	8.0	99.5	3.5	21.9
7	92	97	75	24.2	27	23				
8	88	97	68	23.7	27	21	12.1*	111.6	3.7*	25.6
9	83	97	60	24.9	29	22	0.0	111.6	2.3	27.9
10	88	98	65	24.6	28	20	1.7	113.3	4.2	32.1
11	82	98	62	25.0	29	21	0.0	113.3	4.2	36.3
12	82	97	55	24.5	29	21	0.9	114.2	3.4	39.7
13	86	98	65	25.1	29	22	0.0	114.2	4.0	43.7
14	95	98	80	23.0	26	21				
15	86	98	62	22.9	28	19	12.2*	126.4	5.3*	49.0
16	80	98	50	23.8	30	19	0.0	126.4	5.2	54.2
17	79	97	55	23.6	29	17	0.0	126.4	4.5	58.7
18	83	97	53	25.0	30	22	0.0	126.4	2.2	60.9
19	90	97	76	24.2	27	22	0.9	127.3	2.0	62.9
20	89	98	67	24.3	27	23	4.8	132.1	5.5	68.4
21	92	98	71	22.9	26	20				
22	83	98	56	24.3	29	19	4.4*	136.5	3.2*	71.6
23	85	98	64	24.5	29	21	0.0	136.5	3.7	75.3
24	85	98	63	24.9	29	21	0.0	136.5	3.4	78.7
25	82	98	63	25.4	29	22	0.0	136.5	4.2	82.9
26	80	97	55	24.3	30	19	0.0	136.5	4.9	87.8
27	79	97	51	24.0	30	18	0.0	136.5	10.1	97.9
28	77	97	50	24.4	29	18				
29	79	97	55	24.9	30	19	0.8*	137.3	5.0*	102.9
30	78	96	55	25.8	30	22	17.4	154.7	3.0	105.9
31	84	97	65	25.1	29	22	0.0	154.7	3.3	109.2

x Diario: 85.0	x Diario: 24.3	Tot: 154.7	Tot: 109.2
x Máxima: 97.4	x Máxima: 28.5	x Diario:	x Diario:
x Mínima: 62.6	x Mínima: 20.8	4.8	3.52

LOCALIDAD: 28 MILLAS

* INCLUYE DATO DE DIA ANTERIOR.

CORBANA S.A.
FITOPATOLOGIA

MES: ABRIL AÑO: 1992

	Hum. Relativa			Temperatura			Lluvia - mm		Evaporac.- mm	
	Prom	Max.	Min.	Prom	Max.	Min.	Diaria	Acum.	Diaria	Acum.
1	85	97	65	24.4	28	20	0.0	0.0	3.5	3.5
2	85	98	65	24.5	28	21	0.0	0.0	3.6	7.1
3	85	98	65	25.0	29	22	0.0	0.0	7.5	14.6
4	85	100	61	25.3	31	20	0.0*	0.0	3.5*	18.1
5	84	97	65	25.1	29	21				
6	86	98	70	24.6	28	22	0.0	0.0	4.9	23.0
7	84	98	60	24.5	29	21	0.0	0.0	4.1	27.1
8	85	97	65	24.7	29	21	0.7	0.7	4.5	31.6
9	82	97	56	25.4	30	22	0.0	0.7	3.4	35.0
10	82	97	55	25.0	30	20	0.0	0.7	4.0	39.0
11	86	97	60	25.2	30	21	31.0*	31.7	1.6*	40.6
12	93	97	70	24.3	28	22				
13	90	97	67	24.2	28	21	7.6	39.3	1.6	42.2
14	88	97	60	23.6	29	20	4.7	44.0	12.0	54.2
15	82	97	60	23.3	28	19				
16	87	97	60	24.2	29	19				
17	87	97	66	24.5	28	21	3.1	47.1	7.6	61.8
18	86	97	60	25.2	30	22	0.0*	47.1	3.0*	64.8
19	87	97	69	25.4	29	23				
20	88	98	70	25.0	29	21	0.4	47.5	3.5	68.3
21	86	98	66	24.8	29	21	0.0	47.5	3.6	71.9
22	93	98	72	26.9	32	22	0.0	47.5	3.0	74.9
23	93	97	70	26.6	31	22	4.9	52.4	1.9	76.8
24	90	97	70	24.6	28	23	6.1	58.5	2.0	78.8
25	96	97	80	23.9	27	23	62.4	120.9	1.3*	80.1
26	93	97	84	24.5	27	23				
27	91	97	65	24.1	28	23	113.6	234.5	1.5	81.6
28	92	98	70	23.1	26	21	32.6	267.1	1.2	82.8
29							2.1	269.2*	5.9	88.7
30										
31										

x Diario: 87	x Diario: 24.7	Tot: 269.2	Tot: 88.7
x Máxima: 97	x Máxima: 28.8	x Diario: 8.9	x Diario: 2.8
x Mínima: 66	x Mínima: 21.3		

LOCALIDAD: 28 MILLAS

* Incluye el día posterior.

CORBANA S.A.
FITOPATOLOGIA

MES: MAYO AÑO: 1992

	Hum. Relativa			Temperatura			Lluvia - mm		Evaporac.- mm	
	Prom	Max.	Min.	Prom	Max.	Min.	Diaria	Acum.	Diaria	Acum.
1							5.7	5.7	6.0	6.0
2							13.0*	18.7	1.6*	7.6
3										
4							33.4	52.1	0.7	8.3
5							1.0	53.1	3.6	11.9
6							0.0	53.1	3.0	14.9
7							30.7	83.8	0.0	14.9
8	98	98	96	24.6	26	24	206.5	290.3	1.7	16.6
9	93	98	80	26.0	29	23	101.2*	391.5	1.5*	18.1
10	96	97	90	26.4	28	25				
11	91	97	71	26.7	30	25	25.3	416.8	0.9	19.0
12	95	99	82	25.2	28	24	30.4	447.2	3.6	22.6
13	84	98	58	26.0	30	22	0.0	447.2	4.5	27.1
14	79	97	50	25.3	31	19	0.0	447.2	4.4	31.5
15	81	97	58	25.6	31	23	0.0	447.2	8.2	39.7
16	84	97	64	26.5	31	23	2.3*	449.5	3.4*	43.1
17	79	97	50	26.9	32	21				
18	84	97	59	27.1	32	23	0.0	449.5	3.6	46.7
19	83	97	62	27.4	31	23	0.0	449.5	2.6	49.3
20	88	97	57	26.3	32	24	0.0	449.5	3.4	52.7
21	84	97	60	26.7	33	23	1.0	450.5	1.5	54.2
22	91	97	70	25.7	30	23	2.9	453.4	6.1	60.3
23	86	97	72	26.8	30	23	20.5*	473.9	2.1*	62.4
24	84	97	56	27.1	32	23				
25	89	97	73	25.9	29	24	0.0	473.9	3.9	66.3
26	80	97	55	26.7	31	23	0.0	473.9	3.4	69.7
27	81	97	58	26.2	31	22	0.0	473.9	3.9	73.6
28	81	97	50	26.3	32	21	0.0	473.9	4.7	78.3
29	80	97	52	27.0	33	22	0.0	473.9	8.0	86.3
30	81	97	56	27.4	32	22	0.0*	473.9	5.0*	91.3
31	84	97	58	26.8	32	23				

x Diario: 86 x Diario: 26.3 Tot: 473.9 Tot: 91.3
x Máxima: 97 x Máxima: 30.7 x Diario: 15.2 x Diario: 2.9
x Mínima: 64 x Mínima: 22.8

LOCALIDAD: 28 MILLAS.