HAITI AGROFORESTRY RESEARCH PROJECT

SOUTH EAST CONSORTIUM FOR INTERNATIONAL DEVELOPMENT/

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FACTORS AFFECTING SEEDLING MORTALITY IN HAITIAN AGROFORESTRY

by

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FACTORS AFFECTING SEEDLING MORTALITY IN HAITIAN AGROFORESTRY

Executive Summary

This study examined several factors influencing the mortality of samples of seedlings used in the Agroforestry II Project. Measurements were made of the rootball condition, leaf drop, plant turgor and internal box temperatures of samples of seedlings in selected locations before and after their delivery to farmers. Actual survival rates of species outplanted in farmers' fields were calculated after a minimum of fourteen days. The number of contacts between farmers and animators during the planting and early growth phase was determined. The effectiveness of an extension planting guide in imparting information to farmers was examined.

The four seedling conditions measured in nurseries and in farmers' fields were not shown to have a great influence on seedling survivability. Rootball condition, however, may be a more important influence than was indicated in the particular samples measured. Observations and informal interviews suggest that weeding of planting sites influences survivability. Weeded sites were associated with greater survivability. Seedlings in some unweeded sites were mistakenly weeded later by local work squads. A moderate correlation between the number of extension contacts between animators and farmers, and farmers' knowledge was observed. Greater use of the information in the extension planting guide by animators and farmers could improve the survival of seedlings. Additional site-specific observations are provided. Recommendations to improve seedling planting techniques are offered.

REZIME KREYOL

Rapo sa-a té penché sou plizye kalité bagay ki kapab coz la mo echantiyon ti pye bwa ki itilizé nan Pwoje Agroforestry II. Nou pran mezi sou kondisyon boul rasin-la, kantité fey ki tombé, etat fey yo, si yo red ou pa, ak chale andan bwat echantiyon plantil yo nan kek lokal ni avan, ni apré yo té livré bay plante yo. To survi chak espes ki té planté nan jaden plante yo té kalkilé apre 14 jou. Nou té suiv nom de kontak ent plante yo é animate yo pendan epok plantasyon-an ak premyé pati kwasans ti plantil yo. Kon sa nou té kapab etidyé si enformasyon ak consey animate yo té bay plante yo té genyen youn efe sou komportman plante yo.

Kat kondisyon plantil yo meziré ni nan pepinye, ni nan jaden plante, pat demontré youn gran diferans nan kantité plantil ki reté nan vi. Selman kondisyon boul rasin-la té ka poté youn pi gwo enflians ke mezi echantiyon yo ta endiké. Koté ki té saklé té genyen plis plantil ki viv. Kek nan plantil yo nan koté ki pat saklé te raché nan saklaj pa de travaye sou plas. Nan kek ka nou té remaké ke prezans animate nan zon la té genyen youn efe pozitiv sou konesans plante yo. Si plante yo sevi ak konesans sa-yo li kapab edé plis nan ti plantil yo viv. Lot enfomasyon sou obsevasyon fet sou plas disponib nan rapo-saa ensem ak konsey sou teknik pou edé ti plantil pousé pi byen.

INTRODUCTION

One of the most pressing worldwide problems today is the current rate of deforestation especially in the humid tropics. Deforestation has become a more and more acute problem because rapidly increasing populations of rural subsistence farmers in the tropics must compete for a limited amount of arable land which is suited to this type of agriculture and finite quantities of forest products.

Obviously the solution to this serious problem will only be found in sustainable agricultural systems since population pressure and demand for farm land will most likely continue to increase in the near future. One type of sustainable management system which has proven to be effective in maintaining soil fertility as well as providing both soil stabilization and wood products is agroforestry. This approach has been the main emphasis of the Pan American Development Foundation's Agroforestry Outreach Project in Haiti. This project has proven that subsistence farmers are willing to plant and maintain trees.

Since the same amount of effort and money is expended by the AOP regardless of survival rates, it only makes sense to try and increase survival rates and thus maximize the project's efficiency in this respect. In order to increase survival rates, identification of the most important factors which directly bear on survival would be a logical first step. If seedling conditions affecting mortality were examined to determine what effect they have on seedling mortality, then perhaps these factors could be manipulated to improve the survival rates in future planting seasons. Increasing one year standing tree rates would improve the project's efficiency and ultimately its impact on raising Haiti's small rural farmers' standard of living while protecting their limited but sustainable natural resources.

This study was conducted to assess the differences in several selected factors which affect seedling mortality in Proje Pyebwa. In addition this study assessed animator contacts, planting experiences, and knowledge of planting techniques which may also affect seedling mortality. This research was conducted on trees supplied by the Pan American Development Foundation's Agroforestry Outreach Project in Haiti during the spring 1990 planting season. Researchers included Harry Elver, University of Arizona graduate student, and Duverger Jean Vernis, SECID/AUBURN agroforester.

OBJECTIVES

The research attempted to answer the following questions:

1. To determine the differences in the rootball condition, leaf drop, plant turgor, and internal box temperature of PADF AOP seedlings before transportation from the project nurseries and upon arrival at the residences of participating farmers?

2. To determine the actual survival rates by species of outplanted tree seedlings after a minimum of fourteen days in the participating farmers' fields?

3. Is there a correlation between the rootball condition, leaf drop, plant turgor, and internal box temperature and the survival rate of tree seedlings after a minimum of fourteen days?

4. What is the number of the farmer contacts with project animators which conveyed information on planting techniques?

5. Is there a correlation between the number of farmer contacts with the animators and seedling survival rates?

6. What is the degree of knowledge of planting techniques as derived from the "Plante Pyebwa" (extension planting guide)?

7. Is there a correlation between the number of farmer contacts with the animators and their knowledge about the planting techniques as derived from the "Plante Pyebwa" (extension planting guide)?

8. Is there a correlation between tree survival rates and farmers' degree of knowledge of planting techniques as derived from "Plante Pyebwa" (extension planting guide)?

DATA COLLECTION PROCEDURES

The following procedures were followed to collect the data.

I. For the first part of the study, some biographical information was noted for future reference, such as: form number, nursery and location, responsible PVO, location of the delivery, planters name, location of the planting site, and the name of the animator. A sample box was randomly chosen from the boxes being loaded a particular day for delivery. A one percent sample of each species of the seedlings were randomly selected for measurement.

The following seedling conditions were measured: <u>Condition of the rootball.</u> This measurement was an estimate of soil loss as determined by the use of a dot grid. Researchers held the seedling in front of a grid and counted the number of dots visible, which showed the amount of soil that had been lost from the rootball. <u>Plant Turgor.</u> Researchers measured the angle between the third leaf and the seedling stem. In the case of Casuarina equesetifolia the seedling diameter was measured with a micrometer since leaf angle is not a practical measurement with this species. <u>Leaf Drop.</u> Researchers counted the total number of leaves or the number of leaflets on the third leaf depending on the species. <u>Temperature of the Box.</u> Researchers measured this by placing a thermometer in the middle of the seedlings five to ten minutes before the other measurements were started. Researchers took these four measurements during the stages of transportation from just after packing in the nursery until just before planting. They recorded both the time and the date at each stage of the transportation process. Finally the researchers watched the farmers plant their trees and made any comments that were deemed relevant.

II. The second step of the data collection was carried out well after the farmers had planted the seedlings. Most of the samples were taken about four weeks after the trees were delivered. Researchers noted the date of the second measure and then the trees from that particular box were counted in the field to determine the survival percentage. After counting the surviving trees, the researchers asked the farmer's two questions: How many times have you talked to the animator about receiving trees before the actual delivery? How many times had they planted trees with Proje Pyebwa? The farmers were then given a test over pages eight through sixteen of the "liv plante pyebwa" to determine their level of knowledge of planting techniques. Finally, other specific comments by the farmer or the interviewers were recorded.

LIMITATIONS OF THE STUDY

All of the data for this study was collected at two sites (Bainet and Vialet) during May and June of the spring of 1990 planting season. The researcher had hoped to collect thirty or more samples in four selected sites. Originally this study proposed to collect data from two sites from both the O'Cayes and Bainet/Vialet areas but due to extenuating circumstances this was not possible. In total, researchers visited 18 planting sites. These are the samples used in the data analysis in this study.

Survival rate data for this research was calculated by comparing the number of seedlings in each sample box as indicated by the nursery manager with the number of seedlings found by the researcher. Unfortunately, this number of seedlings of each species was not always correct with what the researchers found while doing the survival counts.

Because of this, the survival percentages used in the data analysis are not one hundred percent correct in eight of the samples but they should be at least in the correct magnitude to still be of value. Whenever possible these instances in the data were eliminated from the analysis.

DATA ANALYSIS

The following table will be used as a set of definitions for the values of the correlation coefficient:

	Value of r	Call it
	+0.80 to 1.00	Extra High
Positive	+0.60 to 0.80	High
Correlation	+0.40 to 0.60	Moderate
	+0.20 to 0.40	Low
	-0.20 to 0.20	Nil
	-0.20 to -0.40	Low
Negative	-0.40 to -0.60	Moderate
Correlation	-0.60 to -0.80	High
	-0.80 to -1.00	Extra High

Objective I: What are the differences in rootball condition, leaf drop, plant turgor, and the internal box temperature of seedlings before and after transportation to farmers planting sites?

A. Table 1. Differences in rootball condition of seedlings before transportation and upon arrival at the planting site.

Sample	pre-transportation soil loss (%)	post-transportation soil loss (%)	difference (%)
1	13.2	31.8	18.6
2	18.2	32.6	14.4
3	52.2	73.0	20.5
4	40.0	66.0	26.0
5	22.5	66.7	44.2
6	10.5	17.3	6.8
7	18.6	30.5	11.9
8	30.4	33.3	2.9
9	33.3	39.4	6.1
10	12.7	33.3	20.6
11	14.2	28.3	14.1
12	17.5	24.2	6.7
13	17.1	20.8	3.7
14	25.4	39.2	13.8
15	25.0	39.6	14.6
16	28.8	43.5	14.7
17	25.4	26.7	1.3
18	19.2	32.1	12.9

mean difference 14.1 percent
standard deviation 10.08 percent
minimum percentage loss 1.3
maximum percentage loss 44.2
number of samples 18

The average soil loss from pre-transportation to reaching the farmers field for each sample box was 14.1 percent. The total soil loss measured was 37.4 percent which indicates that of the soil lost approximately one third of this loss is due to the transportation process itself. Soil loss was an important factor to measure but because of the good rainy season its effects may have been somewhat minimized.

B. The leaf drop or the percentage of leaves lost during the transportation of seedlings.

Table 2. Differences in leaf drop of seedlings before transportation and upon arrival at the planting site.

sample	% leaf loss*
1	1.75
2	2.27
3	2.9
4	2.9
5	1.29
6	1.47
7	0.0
8	4.29
9	.38
10	1.19
11	4.24
12	0.0
13	0.0
14	1.5
15	1.14
16	1.14
17	2.57
18	1.14

mean leaf drop 1.68 percent
standard deviation 1.31 percent
minimum 0 percent
maximum 4.29 percent
number of samples 18

* Leaf Loss in this case represents the percent of loss after transportation.

Leaf loss was very slight (average was less than 2 percent with a standard deviation of 1.3) which indicates that this was not a significant problem.

C. The difference in plant turgor before and after the transportation of the seedlings is in table 3..

Table 3. Difference in plant turgor as measured in change in leaf angle before and after transporting the seedlings. *

sample	average change in leaf angle (degrees)
1	11.7
2	6.65
3	23.3
4	6.7
5	11.86
6	7.86
7	5.0
8	1.43
9	6.43
10	3.29
11	2.62
12	2.14
13	4.0
14	4.29
15	4.43
16	10.0
17	4.05
18	9.14

mean 6.94 degrees
standard deviation 5.14 degrees
minimum 1.43 degrees
maximum 23.3 degrees
number of samples 18

* Average change in degrees was calculated by averaging the change in leaf angle whether positive or negative for each sample seedling in that particular sample box. Casuarinas that were in samples 1,2,3,4 were not included because they were not given the same measurement as the other species.

The change in leaf angle was not a good indicator of plant turgor because in this situation sample seedlings which were transported in the bottom of a box were crushed. This crushing caused a decrease in leaf angle indicating a increase in turgor which would be very unlikely to occur in seedlings being transported to the field under these conditions. Since leaf angle was not a good estimation of plant turgor this causes doubt as to the validity of this measurement.

D. The difference in internal box temperature before and after the transportation of the seedlings is in table 4..

Table 4. Difference in internal box temperature before and after transporting the seedlings.

sample	difference in temperature degrees (celsius)
1	3
2	1
3	3
4	0
5	2
6	6
7	5
8	1
9	4
10	-1
11	null
12	3
13	3
14	2
15	3
16	2
17	3
18	-2

mean difference 2.24 degrees
standard deviation 2.02 degrees
minimum difference -2 degrees
maximum difference 6 degrees
number of samples = 17

The difference in internal box temperature (average of 2.2 degrees celsius and a standard deviation of 2.0 degrees) did not appear to be a problem from what this data indicates.

Objective II: To determine the survival rates by species of outplanted tree seedlings after a minimum of fourteen days.

Table 5. Seedling Survival Rates by Species.

Species	Average Survival Rate (%)	s	min	max	n
Casuarina equisetifolia	69.5	19.84	44	90	4
Acacia auriculiformis	60.0	38.64	0	100	14
Cedrela odorata	65.8	25.91	27	100	13
Catalpa longissima	50.0	36.69	0	100	14
Cassia siamea	62.9	28.78	4	100	14
Azadirachta indica	62.2	25.35	25	100	11
Grevillea robusta	55.1	28.50	8	92	17
Eucalyptus camaldulensis	74.0	74.0	24	96	13

Average Survival Rate 70.06 percent

The overall survival rate of outplanted seedlings after a minimum of fourteen days was 70.06 percent. This above average survival can be partially attributed to the plentiful spring rains in both sites. It seems that in both cases the rainfall was above average for the season and well ahead of the yearly average for this time of year. The rainfall data for each site is in appendixes number one and number two.

Objective III. To assess the correlations between rootball condition, leaf drop, plant turgor, and internal box temperature with the overall survival rate.

A. The correlation coefficient for survival and rootball condition (total soil loss by the time of arrival at the planting site) is shown in table 6..

Table 6. The Correlation Data for Survival and Rootball Condition.

survival(X variable)/rootball condition (Y variable) *

correlation coefficient -.18
Y = 48.84 -.16X
Average Survival 70.06 percent
Average Soil Loss 37.68 percent
16 Degrees of Freedom

* Rootball condition in this case is total soil loss at the time of planting.

B. The correlation coefficient for survival and rootball condition (soil loss during the transportation process) is in table 7..

Table 7. The Correlation Data for Survival and Rootball Condition.

survival (X variable)/rootball condition (Y variable)*

correlation coefficient -.32
Y = 26.98 -.18X
Average Survival 70.06 percent
Average Soil Loss 14.1 percent
16 Degrees of Freedom

* Rootball condition in this case is soil loss during the transportation process.

C. The correlation coefficient between survival and leaf drop can be seen in table 8..

Table 8. The Correlation Data for Survival and Leaf Drop.

survival (X variable)/leaf drop (Y variable)

correlation coefficient -.36
Y = 3.54 -.03X
Average Survival 70.06 percent
Average Leaf Drop 1.68 percent
16 Degrees of Freedom

D. The correlation coefficient for survival and plant turgor is as table 9. indicates.

Table 9. The Correlation Data for Survival and Plant Turgor.

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survival/plant turgor*

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survival (X variable)/leaf angle (Y variable)**
correlation coefficient -.11
Y = 9.22 -.03
Average survival 70.06 percent
Average plant turgor 6.94 degrees
16 Degrees of Freedom

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* Without including the Casuarinas in samples 1,2,3,4 because they were not given the same measurement as the other species.

** Average change in degrees is calculated by averaging the change in leaf angle whether positive or negative for each sample seedling in that particular sample box.

E. Finally the correlation coefficient for survival and internal box temperature is as table 10. shows.

Table 10. The Correlation Data for Survival and Internal Box Temperature.

Survival (X variable)/difference in temperature (Y variable)

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correlation coefficient -.08
Y = 3.16-.01
Average Survival 70.06 percent
Average Temperature Difference 2.24 degrees
16 Degrees of Freedom

The correlations between seedling survival and the four factors measured were either nil or very low in each case. Since all of these correlations were insignificant, it appears that seedling mortality is affected by other factors which were not directly measured in this study. Rainfall, weeding practices, differences between farmers, and to some extent site differences could all have had contributed to seedling mortality.

Objective IV. What are the number of farmer contacts with animators for information on planting techniques. This data is contained in table 11..

Table 11. Number of Farmer Contacts with Animators for Planting Information Techniques.

sample*	# animator contacts
1	2
2	0
3	3
4	3
5	2
6	null
7	null
8	0
9	4
10	null
11	2
12	1
13	2
14	0
15	0
16	null
17	3
18	null

mean 1.69 contacts
standard deviation 1.38 contacts
minimum 0 contacts
maximum 4 contacts
number of samples = 13

* Samples 6,7,10,16,18 are not included because these sample boxes were actually planted by project animators themselves.

As the data in table 11 indicate the number of animator contacts for information on planting techniques was 1.69 contacts on average. In theory the planters should have had at least two animator contacts when planting techniques are discussed. First, the farmers were supposed to be initially signed up to receive seedlings and be visited by an animator. Second, all farmers should have been present at a pre-distribution meeting to learn more about planting the seedlings they would be receiving. In some cases the farmers were exposed to the "liv plante pyebwa" briefly once more in the nursery or possibly the field before they actually planted the project seedlings.

One possible reason for the low number of animator contacts among the farmers studied is that some of the animators are not motivated to do two or three contacts with each farmer because of the time and effort it requires on their part.

Objective V. What is the correlation between the number of farmer contacts with animators and the seedling survival rates.

Table 12. The Correlation of Seedling Survival and the Number of Animator Contacts.

survival (X variable)/# animator contacts(Y variable)

correlation coefficient -.04
$Y = 1.89-.002X$
Average Survival 70.06 percent
Average Number of Animator Contacts 1.69 contacts
11 Degrees of Freedom

As the data in table 12 shows there was no correlation between survival and the number of farmer contacts with animators.

Objective VI. What is the degree of knowledge of planting techniques possessed by the participating farmers. This information is found in table 13..

Table 13.. Degree of Knowledge of Planting Techniques Possessed by Farmers.

sample	knowledge of planting tech.*
1	7
2	0
3	7
4	5
5	3
6	9
7	9
8	3
9	6
10	8
11	6
12	9
13	8
14	3
15	4
16	7
17	3
18	7

mean 5.78 correct answers
standard deviation 2.60 correct answers
minimum 0 correct answers
maximum 9 correct answers
number of samples = 18

* Knowledge of planting techniques is determined by asking nine questions from the "liv plante pyebwa" and recording responses and determining the number of correct responses.

* Animators are included since they were planters and could be tested in the same manner as farmers for knowledge of planting techniques.

The knowledge of planting techniques on average was about 5.8 correct answers out of a possible 9 questions from the "liv plante pyebwa". Considering that the number of animator contacts was somewhat lower than expected this statistic is encouraging. Knowledge of planting techniques was adequate but there is room for improvement.

Objective VII. What is the correlation between the number of farmer contacts with animators and the knowledge of planting techniques.

Table 14. The Correlation Between the Farmers Number of Animator Contact and their Knowledge of Planting Techniques.

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animator contacts (X variable)/knowledge of tech.(Y variable)

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correlation coefficient .42
$Y = 3.61 + .78X$
Average # of Animator Contacts 1.69 contacts
Average Knowledge of Planing Techniques 5.78 correct answers
11 Degrees of Freedom

The correlation between the number of farmer contacts with animators and their knowledge of planting techniques was moderate with a correlation coefficient of .42. This is interesting because it does tend to support the idea that if the number of animator contacts was increased the farmers would be more knowledgeable about planting techniques.

Objective VIII. Does a correlation exist between the farmers knowledge of planting techniques and the seedling survival rate.

Table 15. Correlation between the Tree Survival Rate and the Farmer's Knowledge of Planting Techniques.

Survival (X variable)/Knowledge of Techniques (Y variable)

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correlation coefficient .18
$Y = 3.96 +.03X$
Average Survival 70.06 percent
Average Knowledge of Planting Techniques 5.78 correct answers
16 Degrees of Freedom

The correlation coefficient between the tree survival rate and the farmer's knowledge of planting techniques was very low at only .18.

Additional Analysis

The researcher feels that some additional information collected during the study merits analysis although it was not collected specifically to answer a stated objective. Because this additional information is relevant to the seedling mortality, survival is also correlated with: the number of planting experiences, the elapsed time during transportation, and the soil loss during transportation. Also a multiple regression was calculated to determine how much variation in the survival rate could be accounted to: soil loss, leaf drop, plant turgor, and the internal box temperature.

Table 16. The Correlation between the Tree Survival Rate and the Number of Planting Experiences of the Farmers.

survival(X variable)/# of planting experiences (Y variable)

Correlation Coefficient .39
Y = -1.89 +.08X
Average Survival 70.06 percent
Average # of Planting Experiences 3.39 experiences
16 Degrees of Freedom

The correlation between survival and the number of farmer planting experiences was low with a coefficient of only .39.

Table 17. The Correlation between the Tree Survival Rate and the Time Elapsed During the Transportation Process.

survival(X variable)/elapsed time(Y variable)

Correlation Coefficient -.22
Y = 10.82 -.07X
Average Survival 70.06 percent
Average Elapsed Time 6.22 hours
16 Degrees of Freedom

The correlation between the tree survival and the time elapsed during the transportation process was -.22.

Table 18. The Correlation between Tree Survival Rate and the Soil Loss due to Transportation.

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survival(X variable)/soil loss in transportation(Y variable)

Correlation Coefficient -.32
Y = 26.98 -.18X
Average Survival 70.06 percent
Average Soil Loss in Transportation 14.1% percent
16 Degrees of Freedom

The correlation coefficient for the tree survival with the soil loss in transportation was again low at a -.32.

Table 19. The Multiple Regression between Tree Survival Rate and: Rootball Condition *, Leaf Drop, Plant Turgor, and the Internal Box Temperature.

Survival (X variable) / Soil Loss, Leaf Loss, Plant Turgor, and Internal Box Temperature (Y variables)

Correlation Coefficient .52

Y = 87.06 -.56(soil loss) -.47 (leaf loss) -.32 (turgor) -1.41 (temperature difference)
Average Survival 70.06 percent
Average Soil Loss 14.1 percent
Average Leaf Loss 1.68 percent
Average Plant Turgor 6.94 degrees
Average Temperature Difference 2.24 degrees Celsius

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* Rootball condition in this case was the soil lost during the transportation process.

The multiple regression of survival with the rootball condition, leaf drop, plant turgor, and the internal box temperature was only moderate at .52.

Additional Analysis by Individual Species

This analysis by species is included at the request of Arlin Hunsberger, director of PADF. It could have been valuable to have compared the differences between species but due to small sample sizes the majority of these correlations were not significant.

Table 20. The Correlations between Rootball Condition, Leaf Drop, and Plant Turgor with the Survival Rates for Each Species.

<u>Casurina equisetifolia</u>

Survival Rate(X variable)/Rootball Condition (Y variable)*

Correlation coefficient .23
Y = 16.16 +.44X
Average Survival Rate 69.5 percent
Average Soil Loss 47.0 percent
2 Degrees of Freedom

* Rootball condition in this instance was the total soil lost by the time of planting.

Survival Rate(X variable)/Leaf Drop(Y variable)

Correlation coefficient -.94
Y = 8.54 -.08X
Average Survival Rate 69.5 percent
Average Leaf Drop 3.06 percent
2 Degrees of Freedom

Survival Rate(X variable)/Plant Turgor(Y variable)

Correlation coefficient -.27
Y = 6.98 -.03X
Average Survival Rate 69.5 percent
Average Plant Turgor 4.88 percent
2 Degrees of Freedom

Acacia auriculiformis

Survival Rate(X variable)/Rootball Condition (Y variable)*

Correlation coefficient -.43
Y = 41.6916 -.16X
Average Survival Rate 60.0 percent
Average Soil Loss 32.63 percent
12 Degrees of Freedom

Survival Rate(X variable)/Leaf Drop(Y variable)

Correlation coefficient .10
Y = .36 +.004X
Average Survival Rate 60.0 percent
Average Leaf Drop .51 percent
12 Degrees of Freedom

Survival Rate(X variable)/Plant Turgor(Y variable)

Correlation coefficient .04
Y = 6.89 +.008X
Average Survival Rate 60.0 percent
Average Plant Turgor 8.82 percent
12 Degrees of Freedom

Cedrela ordata

Survival Rate(X variable)/Rootball Condition (Y variable)*

Correlation coefficient -.22
Y = 51.94 -.20X
Average Survival Rate 65.8 percent
Average Soil Loss 42.14 percent
14 Degrees of Freedom

Survival Rate(X variable)/Leaf Drop(Y variable)

Correlation coefficient .40
Y = -1.42 +.03X
Average Survival Rate 65.8 percent
Average Leaf Drop .50 percent
11 Degrees of Freedom

Survival Rate(X variable)/Plant Turgor(Y variable)

Correlation coefficient -.04
Y = 3.749 -.01X
Average Survival Rate 60.0 percent
Average Plant Turgor 2.86 percent
11 Degrees of Freedom

Catalpa longissima

Survival Rate(X variable)/Rootball Condition (Y variable)*

Correlation coefficient 0.0
Y = 30.36 +0X
Average Survival Rate 50.0 percent
Average Soil Loss 30.36 percent
12 Degrees of Freedom

Survival Rate(X variable)/Leaf Drop(Y variable)

Correlation coefficient -.60
Y = 11.71 -.11X
Average Survival Rate 50.0 percent
Average Leaf Drop 6.36 percent
12 Degrees of Freedom

Survival Rate(X variable)/Plant Turgor(Y variable)

Correlation coefficient -.07
Y = 4.29 -.01X
Average Survival Rate 60.0 percent
Average Plant Turgor 5.0 degrees
12 Degrees of Freedom

Cassia siamea

Survival Rate(X variable)/Rootball Condition (Y variable)*

Correlation coefficient -.39
Y = 46.43 -.25X
Average Survival Rate 62.9 percent
Average Soil Loss 30.8 percent
12 Degrees of Freedom

Survival Rate(X variable)/Leaf Drop(Y variable)

Correlation coefficient .007
Y = 2.33 +.0009X
Average Survival Rate 62.9
Average Leaf Drop 2.4%
12 Degrees of Freedom

Survival Rate(X variable)/Plant Turgor(Y variable)

Correlation coefficient -.35
Y = 15.36 -.11X
Average Survival Rate 62.9%
Average Plant Turgor 8.6 degrees
12 Degrees of Freedom

<u>Azadirachta indica</u>

Survival Rate(X variable)/Rootball Condition (Y variable)*

Correlation coefficient -.74
Y = 117.22 -1.10X
Average Survival Rate 62.18 percent
Average Soil Loss 50.93 percent
9 Degrees of Freedom

Survival Rate(X variable)/Leaf Drop(Y variable)

Correlation coefficient 1.0
Y = 0 +0X
Average Survival Rate 62.18 percent
Average Leaf Drop 0.0 percent
9 Degrees of Freedom

* There was no leaf loss in the case of Azadirachata indica.

Survival Rate(X variable)/Plant Turgor(Y variable)

Correlation coefficient -.09
Y = 5.79 -.02X
Average Survival Rate 62.18 percent
Average Plant Turgor 4.29 degrees
9 Degrees of Freedom

Grevillea robusta

Survival Rate(X variable)/Rootball Condition (Y variable)*

Correlation coefficient .12
Y = 41.72 +.09X
Average Survival Rate 55.12 percent
Average Soil Loss 46.88 percent
15 Degrees of Freedom

Survival Rate(X variable)/Leaf Drop(Y variable)

Correlation coefficient -.23
Y = 1.23 -.01X
Average Survival Rate 55.12 percent
Average Leaf Drop .52 percent
15 Degrees of Freedom

Survival Rate(X variable)/Plant Turgor(Y variable)

Correlation coefficient .35
Y = -.59 +.04X
Average Survival Rate 55.12 percent
Average Plant Turgor 1.57 degrees
15 Degrees of Freedom

Eucalyptus camldulensis

Survival Rate(X variable)/Rootball Condition (Y variable)*

Correlation coefficient .24
Y = 10.78 +.19X
Average Survival Rate 74.0 percent
Average Soil Loss 24.29 percent
11 Degrees of Freedom

Survival Rate(X variable)/Leaf Drop(Y variable)

Correlation coefficient -.19
Y = .56 -.005X
Average Survival Rate 74.0 percent
Average Leaf Drop .14 percent
11 Degrees of Freedom

Survival Rate(X variable)/Plant Turgor(Y variable)

Correlation coefficient .48
$Y = 2.83 + .06X$
Average Survival Rate 74.0 percent
Average Plant Turgor 7.43 degrees
11 Degrees of Freedom

For each individual species the survival rate was correlated with rootball condition, leaf drop, and the plant turgor. As can be seen in Table 19 the majority of these correlations were nil or low. In the instances where the correlations were better it appears that small sample sizes and chance were most likely the cause.

CONCLUSIONS

All of the data analysis in this study tends to indicate that survival is influenced by a multitude of factors. Many other factors which were not measured in this study certainly appear to have influenced the mortality of the project seedlings. It is significant that the four factors which were studied did not have more influence on survival as was expected.

From talking with the planters and observing the planting sites while doing the survival count portion of this study, it appears that the most common and significant factor that influenced mortality was the weeding of the sites. In some cases, the researchers watched a farmer plant a row of seedlings in a particular location and then on the follow up visit could not find these same seedlings. According to the farmers, they were cut down while the garden was weeded after being planted. In most of the cases, the weeding was done by a "squad" and not the person who necessarily planted the seedlings.

Of all the factors that this study measured, rootball condition was the most important factor because it could be the most easily manipulated by the actions of the project PVO's. Even though the rootball conditions (soil loss) did not have a high correlation with survival rate in this study, I think that had the rainy season not been as good the soil loss would have been a much more significant factor than it was this year.

OTHER OBSERVATIONS

While collecting data, the researchers also recorded observations about anything that seemed to be relevant to the study. Observations were taken regarding: the operation of the nursery, the distribution of the project seedlings, the transportation of seedlings, and the actions of planters while planting the seedlings. These observations are given here as they were taken during the course of this research.

Bainet:

May 2

Researchers noticed that a lot of the root-trainers were not really closed entirely in the racks and because of this all five of the trees had crossed and interconnected roots.

Some planters who had mules or donkeys to transport their trees were taking the plastic sacks out of the cardboard boxes and then stuffing the plastic bags down into the "pay" saddle bags which no doubt caused a lot of the soil loss from the rootballs.

When the trees were taken out of the plastic sacks there was a lot of rootball damage because the trees had been pressed together.

May 3

There was much activity and confusion in the nursery because the nursery manager wasn't able to adequately supervise all of the people who were loading the boxes. There were many farmers and other people who were loading the boxes with little or no control from the nursery manager or the project coordinators or animators.

The nursery records are completed after the deliveries are finished.

May 5

A planter was carrying around a handful of trees and causing unnecessary soil loss.

A planter was dropping the trees into some pre-dug holes from waist height.

Almost none of the trees were planted in a big enough hole.

June 1

The researcher noticed that the bigger Casurina equisetifolia were doing well while the medium sized ones were alright but had lost their branches and were beginning to sprout new branches. The smallest seedlings were not doing well at all and a few of these had already died.

Vialet:

May 9

An animator was watering trees after they were loaded into a box.

Boxes loaded on top of "tap-taps" were dropped while being loaded and were crushed when tied down.

People were carrying around trees by holding the tops while the trees were still in the root-trainers.

While moving the racks to where the boxes were to be loaded, the racks were unnecessarily dropped rather harshly to the ground. This happened on several occasions.

The researcher noticed that the Grevillea robusta that had been transported in the bottom of the box were very dark brown or almost black when they were removed to be planted.

May 11

The researcher saw an animator dropping trees into boxes to be loaded.

The researcher noticed that with the Eucaliptus camaldulensis and the Grevillea robusta on this particular day were very dry and consequently soil loss was happening very easily.

The "tap-taps" really shake and rattle the boxes during transportation.

The researcher noticed that the boxes seemed to be slow to get hot inside even when they had been in the sun a while.

Researchers observed that packed boxes of trees sat in the sun for three hours while the animator waited for the PVO's "agronome" to come and give the money needed for the transportation of the seedlings on a "tap-tap".

My assistant told me that he actually saw the planter pay the animator two gourdes for his box of trees. In several other instances in Vialet we both suspected that this practice was going on but could not be one hundred percent positive.

May 14

An animator was forcing trees into a plastic bag and this was affecting the rootball condition adversely.

The animator was selecting the better looking seedlings from the rack and leaving the smaller, less attractive seedlings.

While talking with several animators in Vialet, it became rather obvious that in general at least the majority of the animators felt they were under-paid and being exploited by the PVO running the Vialet project. These animators told me that for the amount of work they had to do they were under-paid and had been considering quitting the project.

Limbe:

May 25

When the PADF truck was loaded with boxes the boxes which were on the corners were crushed when tied down.

In Limbe they put 110 trees in 3 plastic bags and it seemed to be too many for that size bag.

RECOMMENDATIONS

1. The samples which were selected in this study should be followed up on in the future to measure the long- term survival of the seedlings.

2. Animators should be given more incentive for doing a good job. Because of the lack of motivation among the animators, the quality of animation is adversely affected. Some type of pay raise for the animators would encourage them to make more effort to visit each site and to aid each planter in receiving adequate information about planting their seedlings.

3. Since there was a moderate correlation between extension contacts and knowledge of planting techniques, more emphasis should be placed on making certain that at least two and possibly three contacts between the farmers and the animators occur in the animation system before the seedlings are actually given to the farmers. If the nurseries were to pre-pack boxes, this would create some time that the animators could possibly use to have one last meeting with farmers to review the "liv plante pyebwa" information. In the case of new planters this would be particularly valuable to insure that these new planters understand how best to plant and maintain their trees.

4. Because of the soil loss which was observed, there is a need for more education. People in nursery, the animators, and the farmers should be given more information about seedling handling procedures to try to decrease soil loss from this source.

5. The animation to the farmers should contain more information on: seedling handling, planting techniques, and post planting care. More emphasis on the "Liv Plante Pyebwa" would be appropriate since it has already been developed and is a good resource for both farmers and animators. Specifically, the lessons about marking the newly planted seedlings and digging an adequate hole for planting should be stressed. Since a lot of the mortality seems to be due to losses which occur during weeding of the planting sites, it is important for the planters to mark the seedlings.

6. When a new species is introduced for the first time in a particular nursery more training of the animators and then of the farmers by the animators about the new species should be emphasized.

7. The following recommendations are not based on research

findings and apply specifically to nursery practices:

A. Root-trainers should be filled and closed properly so there is no cross-rooting of the seedlings.

B. There should be better control of the nursery by the nursery manager during seedling distribution to prevent errors while the boxes are being filled. This control could be obtained if the PVO's were to employ workers to pack the boxes of seedlings.

C. There should be no watering of trees after they are removed from the root trainers because this causes too much unnecessary soil loss. Rootballs should be adequately moistened before uplifting to prevent soil loss during the packing process.

D. The animators should be ready to leave the nursery as soon as possible and with no delays when the trees are ready for delivery. Pre-dawn packing of boxes by the nursery people should be considered so there is no waiting by animators and/or farmers at the nursery to receive trees.

E. Trees should not be forced into the plastic bags. More bags should be used and there should be no more than 25 trees per bag. Another possibility would be to return to the use of the plastic sheets instead of the bags to eliminate this problem altogether.

F. There should be no biased selection of seedlings from the racks by the people packing the boxes in the nursery. Possibly this could best be achieved by only using paid nursery people to pack the boxes.

G. Nursery managers should be encouraged to do a better job of making nursery records so the survival data collected will be more accurate. All the nurserymen should be instructed to record the delivery information immediately in the nursery at the time of delivery and not to wait until later to record this information.

8. This study should be undertaken again on a larger scale to obtain some more conclusive findings. This study would ideally be organized in the following way:

A. A director would coordinate all the field level data collection.

B. All the field level personnel would be given collective training and field testing before the actual planting season arrived.

C. Each site selected for data collection would have at least two people to collect the information.

D. It would be better to have only Haitian nationals collecting the data so as to minimize any possible bias introduced by the presence of the foreign data collectors.

E. The study should be conducted on as much as a country wide basis as feasible.

9. The contents of this study could also be changed somewhat to include a treatment group which could then be compared with a control group. This treatment group could be a selected group of farmers who were given controlled animation which would be equivalent to what they should receive from any given animator. The control group would be selected to represent what actually happens in reality. It would be valuable to see if any significant differences between these two groups occur.

Appendix 1

Bainet
Rainfall Data (in millimeters)

January 1, 1990 through June 1, 1990

date	Jan	Feb	Mar	Apr	May
1			81.3		
2	5.6			15.2	128.3
3			6.9		16.5
4				8.9	
5				4.0	27.8
6					19.3
7		2.9	1.8		
8	8.1			26.7	
9		5.0	4.7	23.6	
10	10.7				12.5
11				8.4	
12			12.0	6.9	
13		14.6			
14					
15		20.8		8.9	
16		9.5			
17		13.2		12.0	
18			14.8		
19		1.7			
20			23.5		
21					
22		8.4	18.6	19.8	
23		3.0	25.7	14.3	
24					
25		5.1	66.1		
26			57.9	19.6	
27		18.9	30.4	50.2	
28		6.6	26.7		
29			8.2		
30			23.8	10.0	
31			15.5		

total January - 24.4
total February - 109.7
total March - 417.9
total April - 228.5
total May - 204.4

total for the year through June 1 - 984.9 mm

Appendix 2

Vialet
Rainfall Data (in millimeters)

January 1, 1990 through June 5, 1990

date	Jan	Feb	Mar	Apr	May	Jun
1						5.1
2						
3					25.4	
4	12.7					20.3
5						17.8
6		10.2				
7					12.7	
8		12.7		40.6		
9					10.2	
10						
11				7.6		
12		17.8				
13					63.5	
14				22.9		
15						
16				7.6		
17						
18						
19		35.6				
20		12.7	10.2			
21						
22						
23			15.2			
24						
25						
26			17.8			
27		12.7				
28						
29						
30	43.2					
31			17.8			

total January - 55.9
total February - 101.7
total March - 61.0
total April - 78.7
total May - 111.8
total June - 43.2

total for the year through June 5 - 452.3 mm

Appendix 3: Sample Data Form

FEY RECHESE

INFORMATION GEOGRAPHIE

#____

PEPINYE & LOKALITE:

RESPONSABLE PVO:

KI KOTE NOU RESEWVA YO:

NOM PLANTE:

KI KOTE BWA YO PLANTE:

NOM ANIMATE:

I ETAT DE BWA YO:

ETAJE AVAN TRANSPORT	ETAJE AVAN PLANTE	ETAJE PLANTE
DAT/TAN:	DAT/TAN:	DAT/TON:

ESPESE:
KONDISYON RASIN:
PRESYON FEY:
FEY PEDI:
TANPERATIRE BWAT:

ESPESE:
KONDISYON RASIN:
PRESYON FEY:
FEY PEDI:
TANPERATIRE BWAT:

ESPESE:
KONDISYON RASIN:
PRESYON FEY:
FEY PEDI:
TANPERATIRE BWAT:

ESPESE:
KONDISYON RASIN:
PRESYON FEY:
FEY PEDI:
TANPERATIRE BWAT:

ESPESE:
KONDISYON RASIN:
PRESYON FEY:
FEY PEDI:
TANPERATIRE BWAT:

KOMBIEN BWA\BWAT:1___ 2___ 3___ 4___ 5___ AN TOTAL:____

KOMMANTE:

II PYEBWA KAP VIV:

DAT BWA YO TE RESEVWA:

DAT NAP GADE BWA YO:

ESPESE:	# BWA YO TE PRAN	SAK KI VIV TOUJOU	%VIVANT
1			
2			
3			
4			
5			

III KONBIEN FWA OU TE PALE AVEK ANIMATE:

IV KOMBIEN FWA OU TE PLANTE AVEK PROJE PYEBWA DEJA:

V KI KONASANSE OU GENYEN SOU LIV PLANTE PYEBWA:

		KOREKTE	ENKOREKTE
	KESYON 1		
9-7 6-4 3-0	KESYON 2		
	KESYON 3		
	KESYON 4		
	KESYON 5		
	KESYON 6		
	KESYON 7		
	KESYON 8		
	KESYON 9		

KOMMANTE: