DOE/ET/[illegible]4-T1

TECHNICAL STATUS REPORT

Date: July 14, 1980 -

Period Covered: October 1, 1978 - June 30, 1980

Contract Identification & Number:

Eucalyptus Plantations for Energy Production in Hawaii
DE-FC03-78ET20074

MASTER

Contractor:

BioEnergy Development Corporation
Attention: Thomas B. Crabb
P. O. Box 1801
Hilo, Hawaii 96720

Contract Start & Completion Date:

September 30, 1978 - December 31, 1979

Contract Objective:

The objectives of this project are to investigate a number of options in accomplishing the following:

1. Increase the biomass production of Eucalyptus.
2. Determine the optimum cultural requirements to maximize yield.
3. Assess planting, cultivation, harvesting and transportation equipment requirements, modifying existing equipment if necessary.
4. Determine the optimum mixture of biomass (eucalyptus and bagasse) at the generator for the production of electricity.
5. Evaluate a complete production/conversion system which utilized optimum management conditions in relationship to costs.

Contract Tasks:

Please refer to:

1. Attached correspondence of March 13, 1980 addressed to Bill Lambert.

2. Cost Management Report No. ERDA533M.

Technical Approach or Work Plan Changes:

No technical changes. All technical aspects of the project progressing well.

DISCLAIMER

Technical work accomplished to date:

1. Two replicated space tests of four varying distances.
2. Two post-emergence herbicide tests.
3. Two replicated nutrient tests of 4 levels of nitrogen and phosphate.
4. Three species and legume tests.
5. Preliminary test of various bagasse/woodchip mixes at HCPC generator.
6. Projected Experiment - Comparison between types of Seedling Containers - Super Cells Vs. Stubbies Vs. Pine Cells.
7. Weed Control Test - Treatment Vs. Non-Treatment.
8. Comparisons Between Types of Fertilizers test.
9. Fertilizer - Media Experiment.
10. Osmocote - Media Experiment.
11. Legume Ground Cover (Plan A attached).
12. Species Trial II (Plan B attached).
13. Liming and Micronutrients in the Nursery (Plan C attached).
14. Treble Super Phosphate Media Test (Plan D attached).
15. Forest Soil Mix with Media (Plan E attached).
16. Mycorrhizae Test - Fungi (Plan F attached).
17. Fertilizer Placement Trial (Plan G attached).

Find attached tentative experimental Plan schedule for the remainder of the 1980 year also projected experimental writeups for:

1. Eucalyptus - Ironwood Mix in Ka'u.
2. Species Trial - Ka'u - 2 soil types.
3. Fertilizer NP Trial - Ka'u - 2 soil types.
4. Legume ground cover - Hilo.

Find attached also a summary of BioEnergy Experiments and locations drawn up by Susan Miyasaka (Agronomist and Soil Scientist) for Board of Directors Meeting 7/11/80.

Crop Logging - Foliar Analysis:

Preliminary work and procedures being worked on with implementation of program to follow. Sample leaf determined with samples sent to University of Hawaii and Brewer Analytical Laboratory to gain information on optimum plant nutrient levels.

Environmental Assessment

Work plans for additional acreage both in Hilo and Ka'u being worked on by Hamakua and Ka'u Soil Conservation Service.

Amauulu mauka conservation area will require the hiring of a Botanist and Ornthologist to do a systematic walk through of the area, recording the abundance of endangered or proposed endangered species along transects, and then prepare an Environmental Impact Statement.

Find Susan Miyasaka's Monthly Report for additional information.

Variance Problems:

90 acres have been planted to-date this year of the scheduled 200 acres. 190 acres planted since start of program. We are slightly behind on schedule but should make this up by end of the year.

Planting commenced in Ka'u after two weeks of delay for herbicide application (prior to planting) which eventually was applied by air due to unavailability of ground equipment. This was a "first" as far as Roundup application by aircraft.

Approximately 20 acres cleared in upper Amauulu forest with 1,000 ft. of access road constructed.

Field maintenance continued along Hilo Coast and Ka'u on heavily infested areas of broad leaf weeds and grasses. A gravity feed manual applicator (magic wand or wick) is now in use and Roundup being used to spot spray grasses.

(Find attached Nursery Inventory for June's operation Supervisor's Report for further information).

Cost Variances or Problems:

$32,552 actual expenditure for the month on a planned $43,100. To-date we have spent $214,886 on a planned $230,040.

Our man months requirements were slightly over plan due to additional help required for Ka'u plantings and field maintenance.

1980 agreement scheduled to be signed on the week of 7/14/80 with a budget allowance of $505,000. This is down slightly from the original unofficial amount of $509,540.

Manpower Variances and Problems:

All allowable salaried and hourly positions filled.

Technical Variances or Problems:

No problems. Technical work progressed very well except for repeat of NP fertilizer trial at Ka'u where reliability of results are questionable due to large amount of replants in first trial. (Refer to Technical approach or Work Plan Changes, Page 2 of Technical Status report for further information.)

Summary Status and Forecast:

90 acres cleared and planted to date of 200 acres scheduled in 1980 with 190 acres completed since project start. Slightly behind schedule with catch up required latter part of this year.

Field maintenance requiring more manpower than estimated and situation will continue until acceptable herbicide available. Gravity type applicators being used for Roundup application on grasses.

Ka'u plantings commenced with permanent crew from Hilo area being transported back and forth to insure better quality work and improved die back.

Approximately 20 acres cleared in upper Amauulu forest area and 1,000 ft. access road constructed.

Expenditures for the month $10,000 under plan and $15,000 under plan to-date. Manpower usage over plan due to additional manpower required in field maintenance and Ka'u planting operations.

1980 agreement to be finalized week of 7/14/80 with budget approval around $505,000.

Revised Experiment: Legume Ground Cover

Blocks: 4

Treatments: 4

Plots: 60 ft. x 60 ft. or 18m x 18m

Total Area: 1.3A

Field: F-25A

Species: Eucalyptus grandis

Spacing: 5 ft. x 5 ft. or 1.5m x 1.5m

Measurements to be taken: Tree height, diameter breast high, percent ground cover by legumes.

Field Preparation: Trees will be planted at 5 ft. x 5 ft. spacing, and then 1 shot (4 oz.) of DC-153 will be buried next to each tree. Treble superphosphate will be broadcast-applied either by hand or by whirlybird in an amount equal to that in 1 shot of DC-153. Legume seeds will be broadcast and raked lightly. At 6 months, the trees will receive 2 oz. of A-4 which will be approximately equivalent in N and K_2O to 4 oz. of DC-153. All plots, including the control plots, will receive the same field preparation and fertilizer rates.

Treatments:

1. Control - no legume (blue)
2. Haifa clover - 1 lb./1/3A (red)
3. New Zealand white clover - 1 lb./1/3A (white)
4. Seca Stylo - 1 lb./1/3A (yellow)

Explanation for the revision:

Lana vetch seeds have been ordered by the Molokai Plant Testing Center and we are currently awaiting them. We were not able to obtain any Big Trefoil seeds through FarmCo because of the unavailability of seeds.

PLOT LAYOUT

4			2	1	3			1	2
3	1	2	3	4	1	2	4	4	3

road

PLAN A

Experiment: Species Trial II

Field: F-25A Kamaee

Spacing: 1.5m X 1.5m or 5 ft. X 5 ft.

Treatments: 10

Blocks: 4

Plot Size: 9 trees X 9 trees (Total Trees = 324)

Measured Trees: 5 trees X 5 trees = 25 trees

Total Area Required: 1.1 A

Explanation: These seeds have been sown and are now ready for outplanting.

Treatment	Species		
1	E. saligna	=	s
2	E. grandis	=	g
3	E. urophylla	=	u
4	E. microcorys	=	mi
5	E. dunnii	=	d
6	E. robusta	=	r
7	E. maidenii	=	ma
8	E. botryoides	=	b
9	E. nitens	=	n
10	Acacia mangium	=	a
11	E. viminalis	=	v

PLOT LAYOUT
F-25A Kamaee

BLOCKS				
	ma	mi	r	v
I	a	b	n	u
	g	d	s	
	n	s	mi	
II	g	u	ma	a
	v	b	r	d
	mi	b	g	
III	r	a	d	ma
	s	v	u	n
	r	a	ma	
IV	s	mi	v	u
	d	n	b	g

Experiment: Species Trial II

Treatment	Species	Sowing Dates
1	E. saligna	1/2/80
2	E. grandis	11/12/79
3	E. urophylla	Blocks I, II, III-10/24/79 Block IV - 5/7/79
4	E. microcorys	11/14/79
5	E. dunnii	Blocks I, II, III-10/24/79 Block IV - 5/31/79
6	E. robusta	10/24/79
7	E. maidenii	10/24/79
8	E. botryoides	10/22/79
9	E. nitens	10/22/79
10	Acacia mangium	11/14/79
11	E. viminalis	10/22/79

Experiment: Liming and Micronutrients in the Nursery

Treatments: 8

Blocks: 5

Treatment	Per one batch Osmocote	Micromax	Per one-fourth batch Dolomite
1	1,040g (4 cups)	0	0
2	1,040g	0	87.5
3	1,040g	0	175.0
4	1,040g	0	350.0
5	1,040g	200g	0
6	1,040g	200g	87.5
7	1,040g	200g	175.0
8	1,040g	200g	350.0

Instructions:

Make one batch of media and add 4 cups of Osmocote and no Micromax for treatments 1 through 4. Divide into one-fourth portions, and add the necessary dolomite. One fourth of a batch should fill about 5 trays of pine cells at 200 cells per tray.

Then make another batch of media and add 4 cups of Osmocote and 200g of Micromax. It would be preferable to weigh these amounts out first on a scale. The batch should then be divided into one-fourths and the necessary dolomite added.

The blocks will consist of 2 trays of pine cells at 100 cells per tray.

BLOCKS								
I	7	6	4	5	1	3	8	2
II	4	1	3	6	5	2	7	8
III	1	8	6	4	7	5	2	3
IV	5	7	1	8	2	6	3	4
V	6	2	5	3	8	1	4	7

PLAN C

Experiment: Treble Super Phosphate (TSP) Media Test

Treatments: 4

Blocks: 5

Treatment	TSP Added, g/one-fourth batch
1	0 g
2	81 g
3	162 g
4	243 g

Instructions:

Make one batch of media (1 part peat: 2 parts vermiculite) and add 4 cups (1,040 g) of Osmocote 14-14-14. Then add the specified amounts of TSP to one-fourth of a batch of media.

One block will consist of two trays of 100 pine cell seedlings each. One-fourth of a batch of media should fill about 5 trays of pine cells at 200 cells per tray.

Plot Layout

I	4	2	1	3
II	3	4	2	1
III	1	3	4	2
IV	3	2	1	4
V	2	1	3	4

Experiment: Treble Super Phosphate Media Test

Treatment	TSP, g/1/4 batch	pH	lbs./A P	lbs./A K	lbs./A Ca	lbs./A Mg	mmohs/cm Salinity
1	0	3.9	200	40	< 500	1000	2.30 (1:2)
2	81	3.9	> 200	40	500	1000	2.78 (1:2)
3	162	3.9	> 200	40	750	1000	2.70 (1:2)
4	243	3.8	> 200	40	< 500	1000	2.40 (1:2)

Experiment: Lime plus Micronutrient Media Test

Treatment	G per batch Osmocote	G per batch Micromax	G per 1/4 batch Dolomite	pH	lbs./A P	lbs./A K	lbs./A Ca	lbs./A Mg	mmohs/cm Salinity
1	1040	0	0	3.9	200	40	< 500	1000	2.30 (1:2)
2	1040	0	87.5	--	--	--	--	--	--
3	1040	0	175.0	--	--	--	--	--	--
4	1040	0	350.0	6.2	50	40	2000	1000	1.12 (1:2)
5	1040	200	0	3.7	50	40	Tr	750	2.18 (1:2)
6	1040	200	87.5	4.6	125	40	< 500	750	2.30 (1:2)
7	1040	200	175.0	4.4	75	40	< 500	750	2.30 (1:2)
8	1040	200	350.0	4.4	>200	80	2000	750	2.78 (1:2)

Experiment: Forest Soil Mix with Media

Treatments: 3

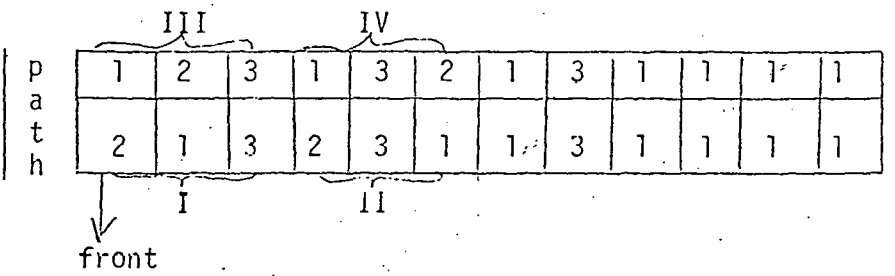
Blocks: 4

Treatment:

1 - Standard media (2 cups Osmocote per batch of media)
2 - Standard media + soil (4:1)
3 - Nitrogano media + soil (4:1)

(11 cups Nitrogano per batch of media)

Layout in Greenhouse



Bench 1 in Greenhouse A

Explanation:

The forest soil was collected from the top 6" of soil from an E. saligna stand at Kamaee mauka. It was hoped that the soil would contain beneficial microorganisms, such as fungal mycorrhizae, which could increase the growth of E. saligna seedlings in the nursery.

In an earlier nursery media experiment, the Nitrogano fertilizer resulted in great variability in growth from plant to plant. It was hypothesized that this variability might have been due to an uneven distribution of microorganisms, since both the Nitrogano and the potting media are pre-sterilized. Addition of the forest soil should give a uniform distribution of microorganisms.

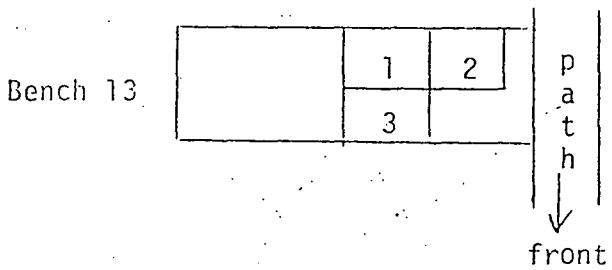
Experiment: Mycorrhizae

Treatments: 3

Experimental Design: Completely Randomized Block

Treatment:
1 - No mycorrhizae added
2 - Mycorrhizae + potting media (1:7)
Inoculum washed free of nutrients and then air-dried for 3 days (dry).
3 - Mycorrhizae + potting media (1:7)
Inoculum not washed free of nutrients (wet)

Greenhouse Layout



Explanation:

Mycorrhizae are beneficial fungi which can infect the roots of Eucalypts, resulting in increased absorption of phosphorus. If we are able to successfully inoculate Eucalypts in the nursery, we will be able to reduce our fertilizer costs by cutting down the plants' requirement for added phosphorus.

Dr. Charles Hodges of the U.S. Forest Service gave us the inoculum of Pisolithus tinctorius, which was originally collected from pine trees. He suggested that we try washing out the nutrients in the mycorrhizae inoculum, as well as leaving the nutrients in the inoculum. The reasoning for this difference in procedures is that mycorrhizae are weak competitors and should become better established under conditions of low fertility. We added 1.25 grams of Osmocote per liter of potting media which is less than half the standard level in order to achieve low fertility conditions.

Revised Experiment:	Fertilizer Placement
Field:	F-26A
Treatments:	4
Design:	Split Plot Design
Area Required:	0.44 A
Plot Size:	40 ft. x 40 ft.
Trees Required:	81 trees/plot x 12 plots = 972 trees
Tree Spacing:	5 ft. x 5 ft.
Tree Species:	E. saligna
Measured Trees:	5 trees x 5 trees or 25 trees
Measurements:	Height, diameter, and time to fertilize

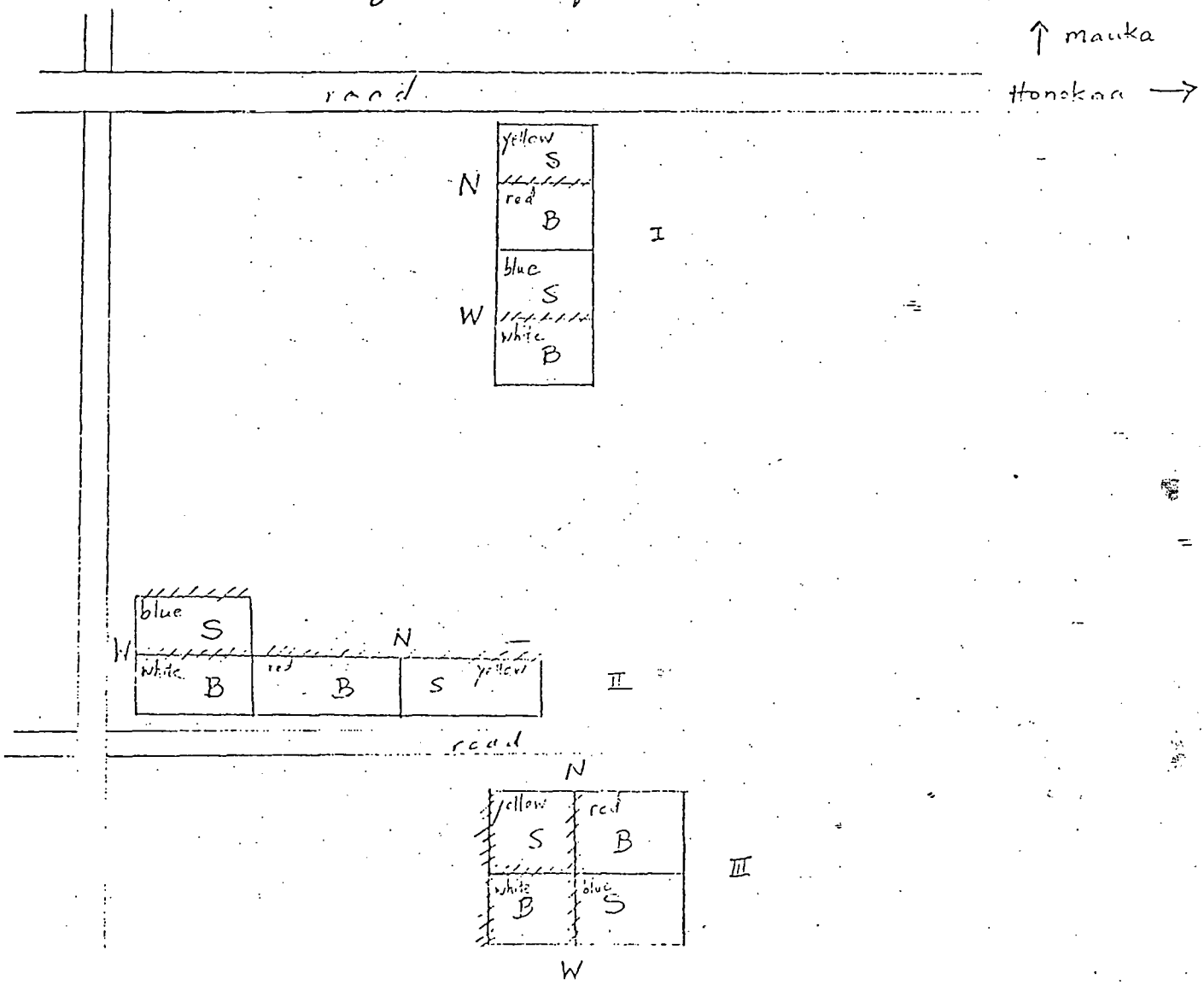
Explanation:

The two methods of fertilizer placement are surface and buried applications. Surface placement is faster and easier; however, the fertilizer will be more readily leached or carried off by surface run-off. Burying the fertilizer in a hole is more time consuming, however the fertilizer will be protected from excessive leaching or movement. Also, phosphorus fixation is a problem in the Akaka soil series and banding is the recommended procedure for fertilizer placement.

A 10 foot border spacing was left around each plot. Ditches were dug around certain plots to prevent run-off from surface fertilized areas from entering the plots.

Expt: Fertilizer Placement Trial

Plot Size: 40 ft. x 40 ft.



N = No weed control

N = Weed control

S = Surface placement

B = Buried placement

//// ditch

BIOENERGY EXPERIMENTS

I. Spacing - Various distances between trees and between rows are being tested to determine the optimum biological and economical spacing.

A. Akaka Falls F-54C
B. Ka'u K-780

II. Fertilizer - Different rates and types of N and P are being tested to determine optimum biological, economical, and energy efficient levels.

A. Akaka Falls F-54C
B. Ka'u K-755
C. Kamaee F-26A

III. Species - Different species of eucalypts and other fast growing trees are being examined for maximum biomass production.

A. Onomea V05-A
B. Kamaee F-25B
C. Ka'u K-755

IV. Legume Intercropping - The effect of interplanting legumes with eucalypts is being tested to see whether nitrogen-fixers transfer nitrogen to the eucalypts.

A. Onomea V05-A
B. Ka'u K-780
C. Kamaee F-25A

V. Herbicide - Several types of herbicide are being tested for maximum weed control with minimum phytotoxicity.

A. Kamaee F-27D
B. Kamaee F-26A

VI. Nursery fertilizer - Different rates and types of fertilizer, as well as various soil amendments, are being tested for maximum seedling growth in the nursery.

A. Media Test
B. TSP Test
C. Lime + Micronutrients

Total number of ongoing or finished experiments - 16.