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4<sup>th</sup> AND 5<sup>th</sup> INTERIM REPORTS

FOR

S. 247

IN VITRO CONSERVATION AND GERMPLASM EXCHANGE OF BAMBOO

HORTICULTURE DEPARTMENT  
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JANUARY, 1987 TO JUNE, 1987.

JULY, 1987 TO DECEMBER, 1987.

## INVESTIGATORS

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## I. INTRODUCTION

The Government of the United States of America, acting through the Agency for International Development (AID) granted a research project entitled; "IN VITRO CONSERVATION AND GERMPLASM EXCHANGE OF BAMBOO" an amount of US \$ 150,000 to the Royal Thai Government. The effective date of this grant started from June 10, 1985 to October 31, 1987. It is agreed that Kasetsart University will act on behalf of the Department of Technical and Economic Cooperation concerning the administration of this grant, and implementing the research Project for the Royal Thai Government.

The ultimate goal is to develop new technology using tissue culture for bamboo conservation and propagation. Specific research objectives include:

- 1). *Development of in vitro conservation techniques;*
- 2). *Collection and conservation of bamboo varieties grown in Thailand and Sri Lanka using tissue culture techniques:*
- 3). *Development of tissue culture techniques for mass propagation; and*
- 4). *Development of techniques for international bamboo germplasm exchange using tissue culture.*

The first interim report covered the activities from June to December, 1985. Contents included laboratory renovation, hiring of technical staff, equipment purchasing and installation and initiation of research activities. The second interim report covered from January to June, 1986. Main emphasis focused on research activities and germplasm collection and administrative work. The third interim report covered from June to December, 1986. This

report covers the 4<sup>th</sup> and the 5<sup>th</sup> interim reports from January, 1987 to June, 1987 and from July, 1987 to December, 1987 the two interim reports are combined and present to the USAID office herewith.

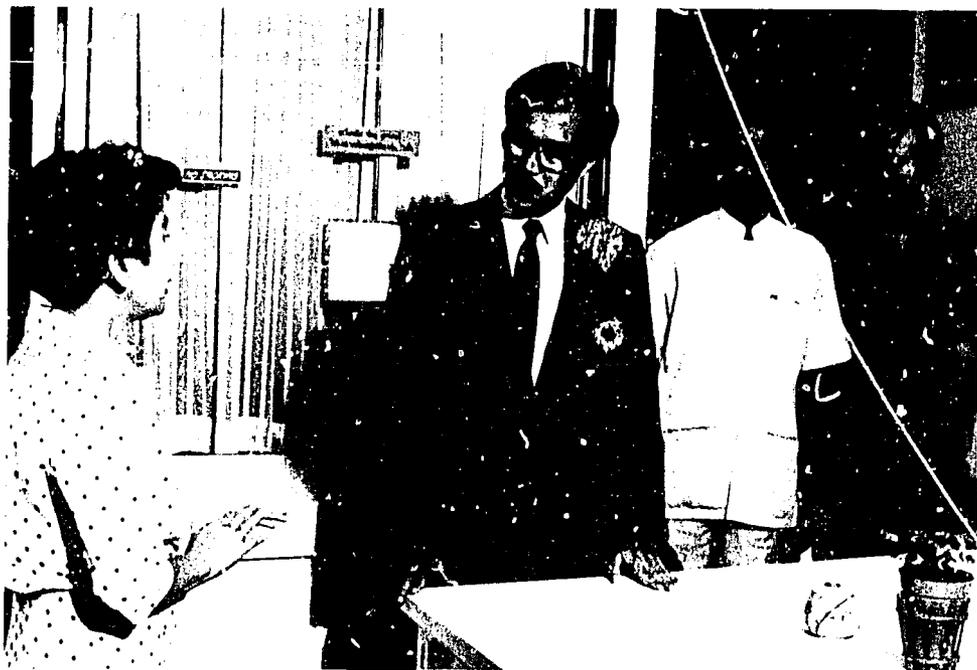
## II. ACTIVITIES

### 1. Prominent visitors:

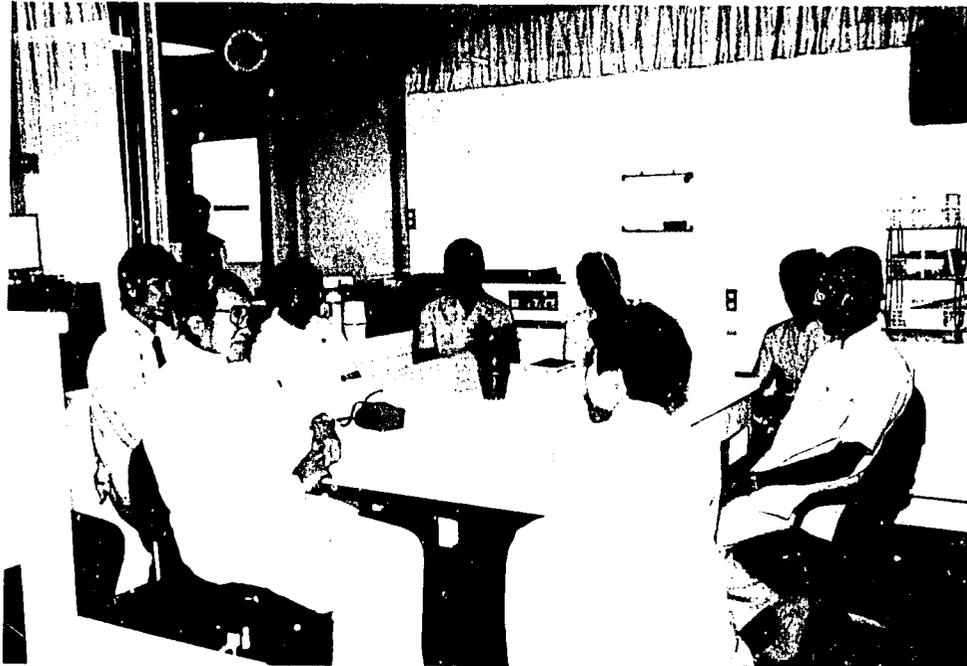
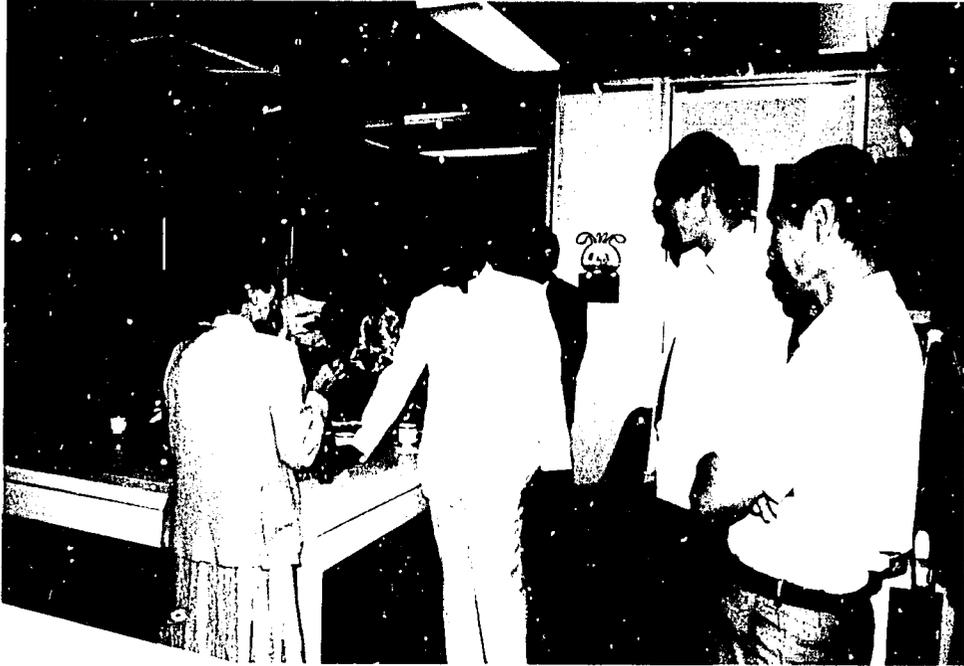
During this report period, January - December, 1987 there were two Thai ministers visiting Bamboo Tissue Culture Laboratory at Kasetsart University. They are : H.E. Bunyat Buntadnan, Minister of Science, Technology and Energy, and H.E. Chaleaw Wacharapuk, Minister of the Interior and bamboo expert.

The Minister of Science, Technology and Energy visited the laboratory on December 21, 1987 accompanied with Dr. Jaroon Kumnuanta, Dr. Gardon Hiebert and Dr. Sutham Areekul who is the Rector of Kasetsart University. The minister interested in the project and its progress. We has expressed his kind willingness to support and assistance. (Picture 1 and 2)

Minister of the Interior H.E. Chaleaw Wacharapuk who is also a bamboo expert, visited Bamboo Tissue Culture Laboratory on December 24, 1987. He was impressed with the nature of the project and progress. He has encouraged the researchers to strengthen the cooperation with other organizations. Furthermore, he suggested that research on bamboo tissue culture and germplasm conservation should be continue. He has expressed his kind support and encouragement. (Picture 3 and 4)



Picture 1,2. H.E. Bunyat Buntadnan, the Minister of Science, Technology and Energy visited Bamboo Tissue Culture Laboratory at Kasetsart University on December 21, 1987.



Picture 3,4. H.E. Chaleaw Wacharapuk, Minister of the Interior and his party visited Bamboo Tissue Culture Laboratory on December 24, 1987.

During this period, several other prominent scientists from foreign countries had also visited Bamboo Tissue Culture Laboratory. As following:-

Dr. C. Nitsch. Gif sur ysette, France

Dr. Jennet Blake. University of London, England

Prof. S.C. Gupta. Delhi University, India

Dr. F.J. Novak. IAEA, Vienna, Austria

etc.

On January 5, 1988 the laboratory had a chance to welcome H.E.Dr. Hans Tuppy, Federal Minister of Science and Research-Austria and his party. That shown in picture 5.



Picture 5. Visitors from Austria H.E.Dr. Hans Tuppy, the Minister of Science and Research and his colleagues.

## 2. Conference and Seminar

Researchers from Bamboo Tissue Culture laboratory, Kasetsart University who have been supported by USAID attended and presented papers at various international and national conferences and seminars. One of them, researcher presented a paper, entitle; " Tissue Culture of Bamboo " at the conference on " Tissue Culture of Forest Tree ", Kuala Lumpure, Malaysia, Organized by Forest Research Insititute of Malaysia and International Development Research Center. 70 scientists from 10 countries attended the seminar: The other conference " Fifth Cycle Commemorative Conference of USAID Science Award Grantees ", principle investigator presented a research progress at the conference organized by USAID, Nakornpathom on July 24-26, 1987.

### III. RESEARCH ACTIVITIES

During January - December, 1987 the research was focused on 2 main aspects, beside germplasm collection, they were:

1. Improvement of tissue culture system for mass propagation, and
2. Develop an in vitro germplasm conservation technique.

The experimental procedures and results could be summarized as following:

#### 1. IMPROVEMENT OF TISSUE CULTURE SYSTEM FOR MASS PROPAGATION.

##### 1.1 Stem-bud segments system:

As earlier report, different kinds of bamboo required different kinds of medium. Though, it was concluded that the medium consisted of; Murashige

and Skoog (MS) basic salt components, 1 mg/l  $\alpha$  - Naphthaleneacetic acid (NAA) and 2 mg/l 6 - Benzylamino purine (BA) was the most suitable medium for bud-break and multiple shoots formation of bamboo, the results showed large variation in success. We therefore decided to continue to improve the medium compositions for the different varieties of bamboo and investigated the effects of various concentrations of sucrose and BA. Some of the results are summarized in Table 1 and 2.

Table 1. Effect of MS<sup>a/</sup> and WP<sup>b/</sup> basal media and various concentrations of BA

Bamboo species	Basal medium	Research	BA (mg/l) <sup>*/</sup>				
			0	5	10	15	20
Experiment series # 1.							
<i>Phyllostachys nana</i>	MS	Multiple shoots	0	+1	+2	+3	+1
		Growth	0	+1	+3	+3	+3
		Color	0	+3	+3	+3	+3
	WP	Multiple shoots	0	+1	+2	+2	+1
		Growth	0	+1	+2	+2	+1
		Color	0	+1	+1	+3	+2
<i>Oxytenanthera albociliata</i>	MS	Multiple shoots	0	0	+1	+1	0
		Growth	0	+1	+1	+1	+1
		Color	+2	+2	+2	+2	+2
	WP	Multiple shoots	0	0	0	0	0
		Growth	0	+1	+1	+1	+1
		Color	+1	+1	+1	0 (br)	0 (br)

a/ MS = Murashige and Skoog medium (1962)

b/ WP = Woody Plant medium (1981)

Table 1. (Cont'd.)

Bamboo species	Basal medium	Research	BA (mg/l) <sup>*/</sup>				
			0	5	10	15	20
Experiment series # 1.							
<i>Arundinaria ciliata</i>	MS	Multiple shoots	+0	+1	+2	+2	+2
		Growth	+0	+1	+2	+2	+1
		Color	+0	+2	+2	+2	+2 (br)
	WP	Multiple shoots	+0	+1	+1	+1	+1
		Growth	+0	+1	+2	+1	+1
		Color	+0	+2	+2	+2	+1 (br)
<i>Dinochloa scandens</i>	MS	Multiple shoots	+1	+1	+1	+1	+1
		Growth	+1	+1	+1	+1	+1
		Color	+2	+2	+2	+2	+2
	WP	Multiple shoots	+0	+1	+1	+1	+0
		Growth	+1	+1	+1	+1	+1
		Color	+1 (br)	+1 (br)	+1 (br)	+1 (br)	+1 (br)

Table 1. (Cont'd.)

Bamboo species	Basal medium	Research	BA (mg/l) <sup>*/</sup>				
			0	5	10	15	20
Experiment series # 1.							
<i>Dendrocalamus asper</i>	MS	Multiple shoots	+ 0	+ 1	+ 1	+ 0	+ 0
		Growth	+ 0	+ 1	+ 1	+ 0	+ 0
		Color	+ 0	+ 1	+ 1	+ 0	+ 0
	WP	Multiple shoots	+ 0	+ 0	+ 0	+ 1	+ 1
		Growth	+ 0	+ 0	+ 0	+ 1	+ 1
		Color	+ 0	+ 0	+ 0	+ 1	+ 1
Experiment series # 2.							
<i>Schizostachyum aciculare</i> clone I	MS	Multiple shoots	+ 0	+ 0	+ 0	+ 1	+ 1
		Growth	+ 0	+ 1	+ 1	+ 1	+ 1
		Color	+ 0	+ 1	+ 1	+ 2	+ 2
<i>Schizostachyum aciculare</i> clone II	MS	Multiple shoots	+ 0	+ 0	+ 0	+ 1	+ 1
		Growth	+ 0	+ 1	+ 1	+ 1	+ 1
		Color	+ 0	+ 1	+ 1	+ 2	+ 1

Table 1. (Cont' d.)

Bamboo species	Basal medium	Research	BA (mg/l) <sup>*/</sup>				
			0	5	10	15	20
Experiment series # 2.							
<i>Phyllostachys nana</i>	MS	Multiple shoots	+ 0	+ 1	+ 3	+ 2	+ 3
		Growth	+ 0	+ 1	+ 2	+ 2	+ 1
		Color	+ 1	+ 1	+ 2	+ 2	+ 2
<i>Bambusa glucescens</i>	MS	Multiple shoots	+ 0	+ 1	+ 2	+ 1	+ 2
		Growth	+ 0	+ 2	+ 2	+ 2	+ 2
		Color	+ 0	+ 2	+ 2	+ 2	+ 2
<i>Bambusa vulgaris</i>	MS	Multiple shoots	+ 0	+ 1	+ 1	+ 1	+ 2
		Growth	+ 2	+ 2	+ 2	+ 2	+ 2
		Color	+ 2	+ 1	+ 1	+ 1	+ 1

<sup>\*/</sup> = Rating scores were given according to relative comparisons; as the following guidelines:-

- 0 = no growth, no branch, yellowish in color and often die.
- +1 = slight growth, some branches, yellowish green in color.
- +2 = average in growth, some branches, green in color.
- +3 = rapid growth, many branches (shoots), green in color.
- (br) = tissue turned brown.

Table 2. Effect of sucrose concentrations on growth and multiple shoots formation in bamboo.

Bamboo species	Basal medium	Research	Sucrose (gm/l) <sup>1/</sup>					
			30	30+ac <sup>2/</sup>	40	40+ac <sup>2/</sup>	50	50+ac <sup>2/</sup>
<i>Bambusa ventricosa variegatus</i>	MS <sub>1</sub>	Multiple shoots	+0	+0	+0	+0	+0	+0
		Growth	+1	+2	+2	+2	+2	+2
		Color	+2	+2	+2	+2	+2	+2
<i>Bambusa glaucescens</i>	MS <sub>1</sub>	Multiple shoots	+2	+0	+2	+0	+1	+0
		Growth	+1	+1	+2	+1	+1	+1
		Color	+2	+2	+2	+2	+2	+2
<i>Bambusa ventricosa</i>	MS <sub>1</sub>	Multiple shoots	+0	+0	+1	+0	+0	+0
		Growth	+2	+1	+3	+2	+2	+2
		Color	+2	+2	+2	+2	+2	+2

MS<sub>1</sub> = MS + 1 mg/l NAA + 2 mg/l BA

<sup>1/</sup> = rating scores were given according to relative comparisons; as the following guidelines:-

0 = no growth, no branch, yellowish in color and often die.

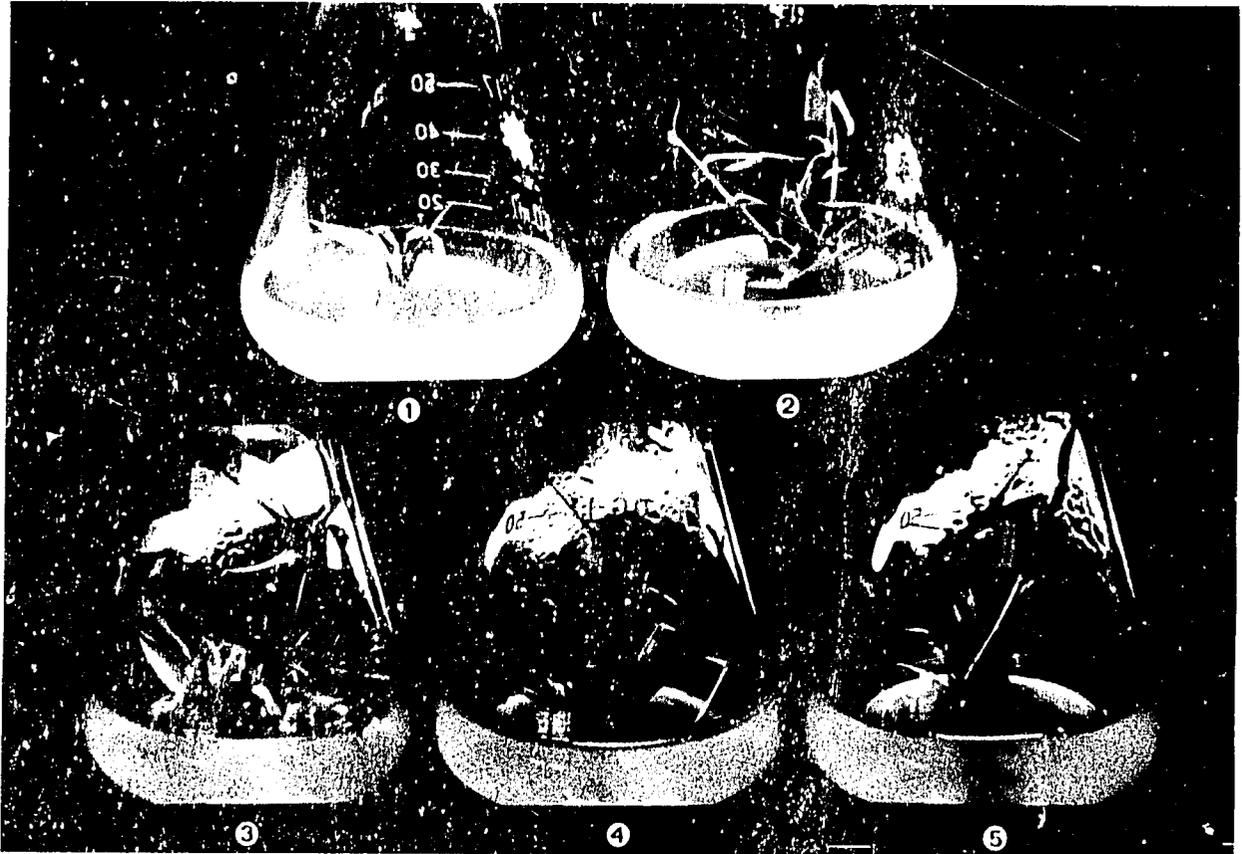
+1 = slight growth, some branches, yellowish green in color.

+2 = average in growth, some branches, green in color.

+3 = rapid growth, many branches (shoots), green in color.

(br) = tissue turned brown.

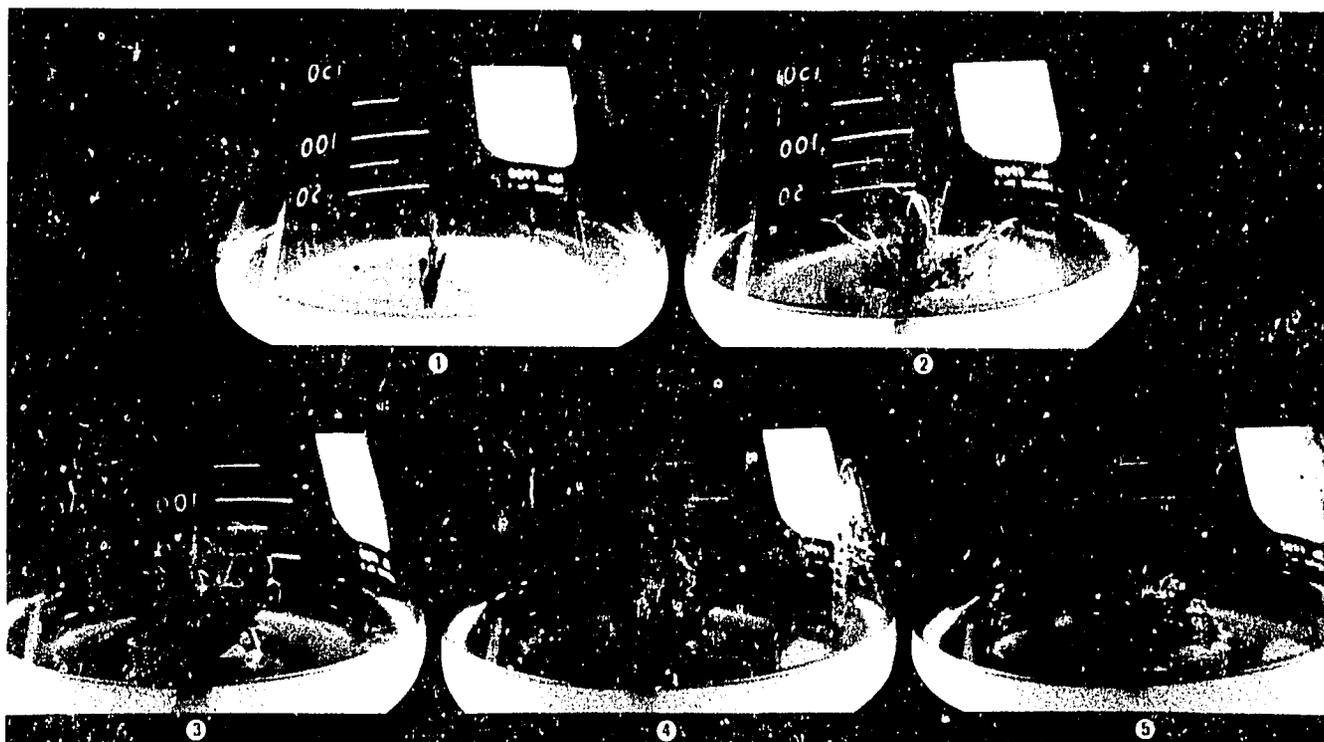
<sup>2/ac</sup> = activated charcoal.



Picture 6. Multiple shoots formation of *F. villosa* in 1 month after sub-culture to the medium which vary BA concentration.

(Experiment series # 1)

- 1 = MS + 0 mg/l BA + 3% sucrose
- 2 = MS + 5 mg/l BA + 3% sucrose
- 3 = MS + 10 mg/l BA + 3% sucrose
- 4 = MS + 15 mg/l BA + 3% sucrose
- 5 = MS + 20 mg/l BA + 3% sucrose



Picture 7. Similarly response, after 1 month of incubation when sub-culture the young stage of shoots of *Phyllostachys nana* to various concentration of BA. (Experiment series # 2)

- 1 = MS + 0 mg/l BA + 3% sucrose
- 2 = MS + 5 mg/l BA + 3% sucrose
- 3 = MS + 10 mg/l BA + 3% sucrose
- 4 = MS + 15 mg/l BA + 3% sucrose
- 5 = MS + 20 mg/l BA + 3% sucrose



### 1.2 Leaf callus system.

As for leaf callus system; research was conducted to induce callus formation, callus growth and regeneration. Beside *Bambusa flexuosa*, which has been previously reported, no other species has been successfully regenerated into plantlets. A number of experiments have been tried without success. Factors affecting callus growth and callus formation ie NAD and kinetin have been investigated. Experiments are in progress. Research on regenerated plantlets from callus in various species have been continue.

### 1.3 Transplanting experiments.

Research was conducted to develop the best transplanting procedure. In summary, bamboo plantlets, either regenerated from leaf callus or stem-segment tissue, could be transplanted successfully into soil. The percentage of survival rate could be acheived as high as 100.



Picture 9. Transplanting of bamboo plantlets from in vitro cultures.

left = *Gephalostachyum pergracile*.

right = *Dendrocalamus* sp. (Pai-Dam) after 2 months trans-  
planting.



Picture 10. Plantlet of *Dendrocalamus membranaceus* after 7 months transplanting.

## 2. DEVELOP AN IN VITRO GERMPLASM CONSERVATION TECHNIQUE

Several experiments were conducted. The results are summarized as below:

### 2.1 Low temperature technique.

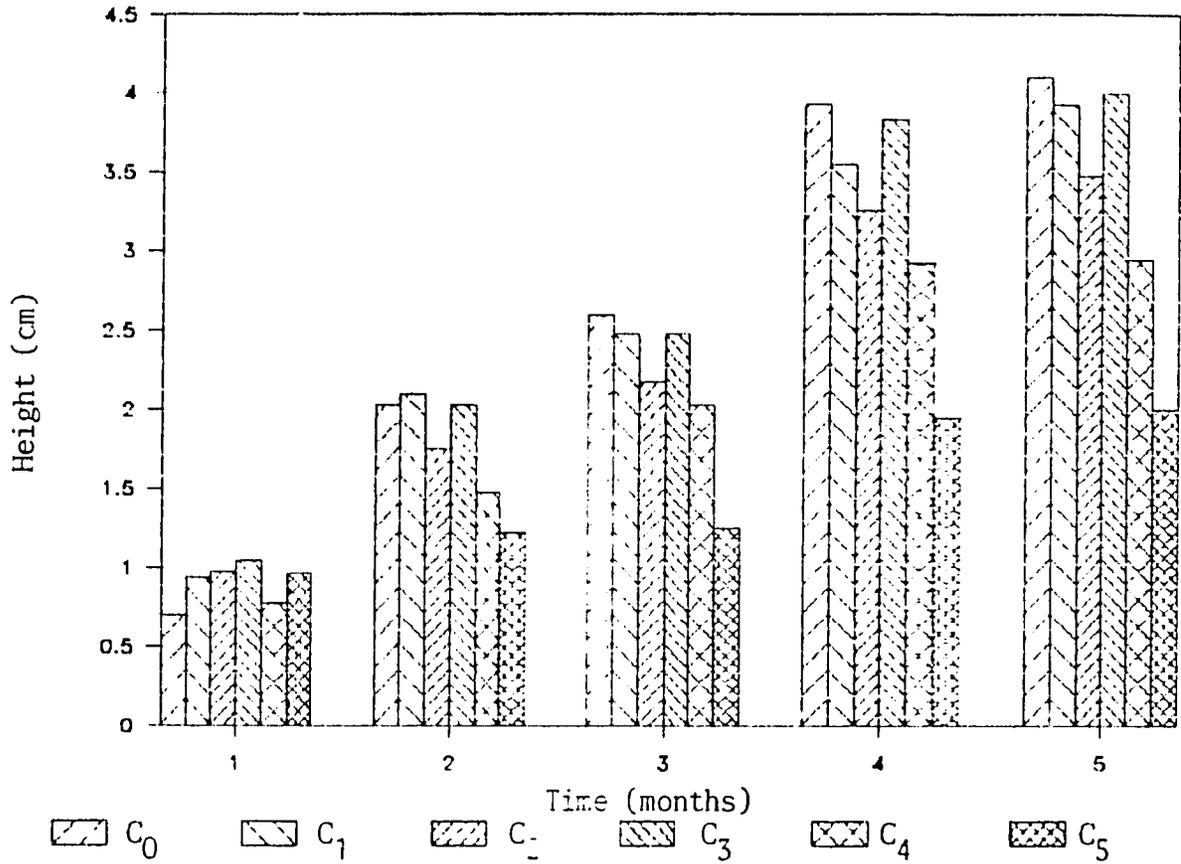
- a. It was confirmed that bamboo shootlet without root could be kept at 5°C in tissue culture medium for 3 months. At 4 months, many shootlets died.
- b. At 5°C, growth (height) occurred within the first weeks, then stop growing.
- c. It was suggested that light was needed if shootlet was incubated at 25°C but did not required if shootlet was incubated at 5°C.

### 2.2 Growth retardant technique.

Experiments were conducted to evaluate the effect of growth retardant on growth and survival of bamboo plantlets. Various concentrations of CCC and daminozide were incorporated into the medium. Table 3 & 4 and picture 11 & 12 showed the conclusive results of experiments.

Table 3. Effects of CCC on the survival of *Dendrocalamus sp.* (Pai-Dam) plantlets after 5 months of incubation.

Treatments (mg/l)	% survival
Control (CCC 0 mg/l)	100
CCC 250 mg/l	100
CCC 500 mg/l	100
CCC 1,000 mg/l	100
CCC 2,000 mg/l	50
CCC 4,000 mg/l	25

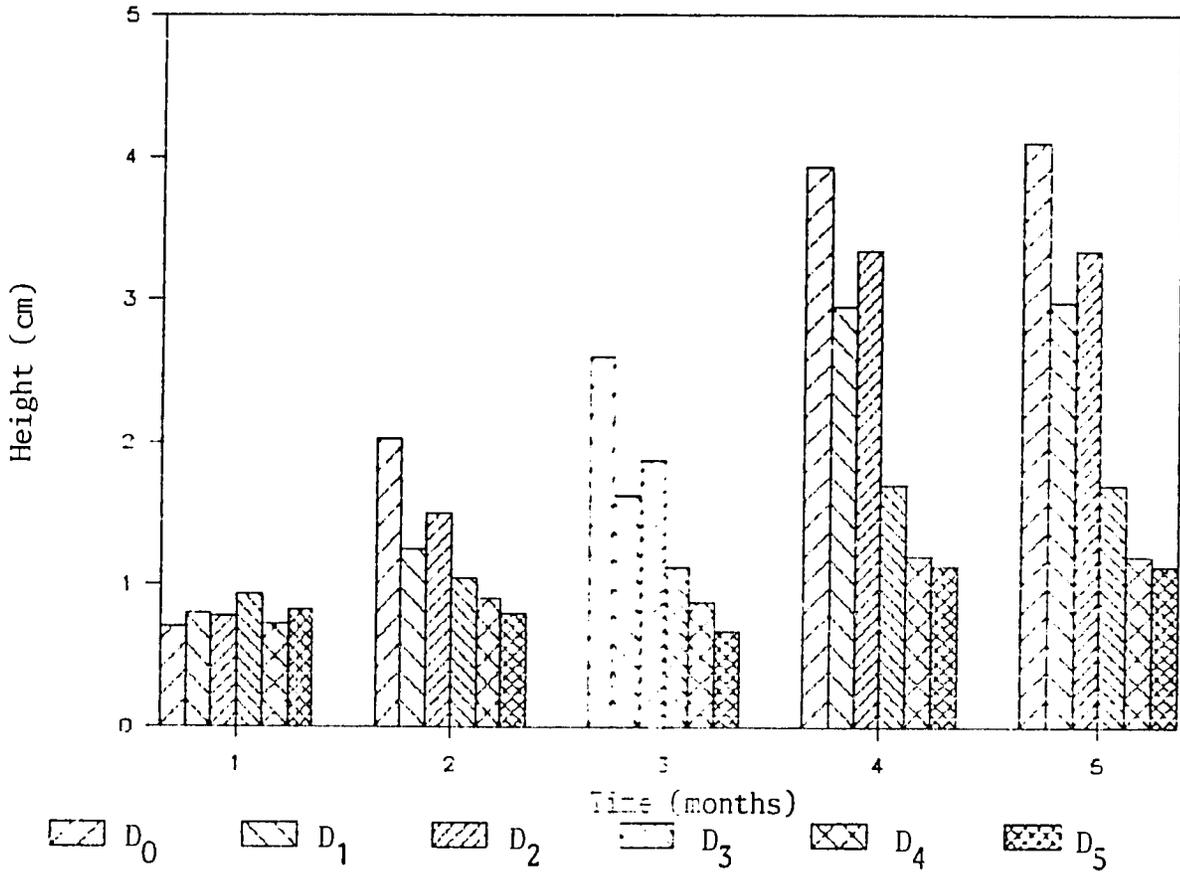


Picture 11. Effect of CCC on height of *Dendrocalamus sp.* (Pai-Dam) plantlets after 5 months of incubation.

C<sub>0</sub> = CCC            0 mg/l  
C<sub>1</sub> = CCC            250 mg/l  
C<sub>2</sub> = CCC            500 mg/l  
C<sub>3</sub> = CCC            1,000 mg/l  
C<sub>4</sub> = CCC            2,000 mg/l  
C<sub>5</sub> = CCC            4,000 mg/l

Table 4. Effect of daminozide on the survival of *Dendrocalamus sp.* (Pai-Dam) plantlets after 5 months of incubation.

Treatments (mg/l)	% survival
Control	100
Daminozide 250 mg/l	100
Daminozide 500 mg/l	75
Daminozide 1,000 mg/l	0
Daminozide 2,000 mg/l	0
Daminozide 4,000 mg/l	0



Picture 12. Effect of daminozide on height of *Dendrocalamus sp.* (Pai-Dam) plantlets after 5 months of incubation.

- D<sub>0</sub> = daminozide 0 mg/l
- D<sub>1</sub> = daminozide 250 mg/l
- D<sub>2</sub> = daminozide 500 mg/l
- D<sub>3</sub> = daminozide 1,000 mg/l
- D<sub>4</sub> = daminozide 2,000 mg/l
- D<sub>5</sub> = daminozide 4,000 mg/l

c. Cryopreservation.

Preliminary experiments were conducted to investigate the effect of cryopreservative agents ie DMSO, Glycerol. Tissue were kept in refrigerator overnight and then kept at  $-85^{\circ}\text{C}$  (deep freeze) or in liquid  $\text{N}_2$  ( $-196^{\circ}\text{C}$ ). After fast thawing process in water bath, all tissues did not survive. The failure of experiment could be the unappropriate temperature reduction and improper handling. Equipments ie temperature controlling programmer, which are necessary for such research have not yet arrive at that time. Experiments will be conducted again as soon as the equipment arrive and set.

IV. GERmplasm COLLECTION

Table 5 Shows the availability of bamboo germplasms in vitro at USAID-KU Bamboo Tissue Culture Laboratory.

Table 6 Shows the activities of germplasm collection during January to December, 1987.

Table 5 Availability of Bamboo germplasm in vitro at USAID-KU Bamboo Tissue Culture Laboratory.

Bamboo species	Types of collected tissue <u>in vitro</u>
1. <i>Arundinaria suberecta</i>	plantlets
2. <i>A. pusilla</i>	multiple shoots
3. <i>Bambusa arundinacea</i>	buds
4. <i>B. glaucescens</i>	multiple shoots
5. <i>B. ventricosa</i>	buds
6. <i>B. vulgaris</i>	multiple shoots
7. <i>Dendrocalamus asper</i>	buds
8. <i>D. membranaceus</i>	buds
9. <i>D. strictus</i>	buds
10. <i>Dinochloa scandens</i>	buds
11. <i>Gigantochloa auriculata</i>	buds
12. <i>G. albociliata</i>	buds
13. <i>G. compressa</i>	buds
14. <i>Melocalamus compactiflorus</i>	multiple shoots
15. <i>Phyllostachys nana</i>	multiple shoots
16. <i>Thyrsotachys oliveri</i>	buds
17. <i>T. siamensis</i>	multiple shoots

Table 6. Status of Bamboo Collection and Cultures. (January - December, 1987.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
January 9, 1987.	<i>Bambusa burmanica</i>	-	Bangkok		/	D
	<i>B. flexuosa</i>	-			/	D
January 23, 1987.	<i>Arundinaria ciliata</i>	-	Bangkok		/	D
	<i>A. pusilla</i>	-		/		G
	<i>Bambusa sp.</i>	Pai-Keaw		/		G
	<i>B. burmanica</i>	Bong-Van			/	D
	<i>B. gracilis</i>	-			/	D
	<i>B. nigra</i>	Pai-Dam		/		P
	<i>B. nutans</i>	-			/	H
	<i>B. polymorpha</i>	-			/	D
	<i>Oxytenanthera albociliata</i>	-		/		G, C
	<i>Schizostachym aciculare</i>	-			/	D
January 27, 1987.	<i>Bambusa ventricosa</i>	-	Bangkok	/		G
	<i>Dendrocalamus sp.</i>	Pai-Maju	Chiangmai	/		G
	<i>Phyllostachys nana</i>	-		/		G
	<i>Phyllostachys sulphurea</i>	-		/		C

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
February 6, 1987.	<i>Dinochloa scandens</i>	-	Nakornrachasima		/	D
February 23, 1987.	<i>Bambusa nigra</i>	-	Chiangmai		/	D
	<i>B. ventricosa variegatus</i>	-		/		G
	<i>Dendrocalamus asper</i>	Tong-Keaw		/		G
	<i>D. longispathus</i>	-		/		G
	<i>Phyllostachys sulphurea</i>	-			/	D
	<i>Sasa fortunei</i>	-			/	D
March 4, 1987.	<i>Bambusa glaucescens</i>	-	Bangkok	/		G
	<i>B. ventricosa</i>	-		/		G
March 9, 1987.	<i>Bambusa polymorpha</i>	-	Chiangmai		/	D
	<i>Schizostachym aciculare</i>	1		/		D
	<i>S. aciculare</i>	2		/		H
March 11, 1987.	<i>Bambusa vulgaris</i>	-	Bangkok	/		G, C
March 19, 1987.	<i>Phyllostachys nana</i>	-	Bangkok	/		G
March 25, 1987.	<i>Bambusa glaucescens</i>	-	Bangkok	/		G
	<i>B. nigra</i>	-			/	D
	<i>Phyllostachys sulphurea</i>	-		/		G

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>	
				survive	death		
March 26, 1987.	<i>Bambusa vulgaris</i>	-	Bangkok	/		G	
March 30, 1987.	<i>Bambusa flexuosa</i>	-	Pratumtanee		/	D	
April 6, 1987.	<i>Bambusa burmanica</i>	Bong-Van	Nakornsritam- mara	/		C	
	<i>B. ventricosa</i>	-		/		G	
	<i>B. vulgaris</i>	-		/		C	
April 15, 1987.	<i>Arundinaria pusilla</i>	-	Bangkok	/		G	
	<i>Dendrocalamus asper</i>	Tong-Keaw		/		G	
April 16, 1987.	<i>Bambusa sp.</i>	Pai-Keaw	Bangkok	/		G, C	
April 22, 1987.	<i>Bambusa sp.</i>	Pai-Keaw	Kanchanaburi	/		G, C	
	<i>Cephalostachyum pergracile</i>	-			/		H
	<i>Dendrocalamus membranaceus</i>	-				/	D
	<i>Gigantochloa hasskarliana</i>	-				/	D
	<i>Melocalamus compactiflorus</i>	-				/	D
	<i>Thyrsostachys siamensis</i>	-			/		G
April 27, 1987.	<i>Bambusa burmanica</i>	Bong-Van	Nakornpathom		/	D	

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>	
				survive	death		
April 29, 1987.	<i>Bambusa sp.</i>	Bong-Neaw	Prajinburi	/		G	
	<i>Bambusa sp.</i>	Pai-Keaw		/		G, P	
	<i>B. arundinaceae</i>	(Pijit)				/	H
	<i>B. blumeana</i>	(Kampaengpetch)				/	D
	<i>B. burmanica</i>	Bong-Ban				/	D
	<i>B. burmanica</i>	(Uttaradit)				/	D
	<i>B. burmanica</i>	Bong-Van		/			G
	<i>B. glaucescens</i>	(Payao)				/	D
	<i>B. glaucescens</i>	(Konkaen)				/	D
	<i>B. longispiculata</i>	-				/	H
	<i>B. nana</i>	-				/	D
	<i>Dendrocalamus asper</i>	Tong-Van				/	H
	<i>D. asper</i>	Tong-Moo				/	H
	<i>D. asper</i>	Tong-Keaw				/	H
	<i>D. asper</i>	Tong-Dan				/	H
	<i>D. sericeus</i>	-				/	H
	<i>Gigantochloa auriculata</i>	(Pak-Tai)		/			G, C
	<i>G. compressa</i>	-		/			H
<i>G. hosseusii</i>	-			/	H		
<i>Schizostachyum brachycladium</i>	-			/	H		
<i>Thyrsostachys oliveri</i>	-			/	H		

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
May 12, 1987.	<i>Arundinarea pusilla</i>	-	Bangkok		/	D
	<i>Bambusa arundinaceae</i>	-		/		G
	<i>Dendrocalamus membranaceus</i>	-		/		G
	<i>D. strictus</i>	-		/		G
	<i>Thyrsostachys siamensis</i>	-			/	D
May 19, 1987.	<i>Bambusa vulgaris</i>	-	Bangkok	/		G
May 21, 1987.	<i>Arundinarea suberecta</i>	-	Bangkok	/		G
	<i>Bambusa burmanica</i>	Bong-Van			/	D
	<i>B. ventricosa</i>	-			/	D
	<i>Dendrocalamus asper</i>	Tong-Van			/	D
	<i>Thyrsostachys siamensis</i>	Rauk-Lek			/	D
May 26, 1987.	<i>Arundinarea auricoma</i>	Thong-Dang	Chaingmai	/		P
	<i>Bambusa arundinaceae</i>	-			/	D
	<i>B. multiplex</i>	(Nepal)		/		G
	<i>B. tulda</i>	-			/	D
	<i>B. ventricosa variegatus</i>	-		/		P
	<i>Dendrocalamus asper</i>	Tong-Van		/	D	

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>	
				survive	death		
May 28, 1987.	<i>D. asper</i>	Tong-Keaw	Prajinburi		/	D	
	<i>D. brandisii</i>	-		/		D	
	<i>D. strictus</i>	Sang-Reab		/		D	
	<i>Oxytenanthera albociliata</i>	-		/		P	
	<i>Phyllostachys humillis</i>	-		/		P	
	<i>Phyllostachys nana</i>	-		/		P	
	<i>Schizostachyum aciculare</i>	(Nepal)			/		G
	<i>Bambusa sp.</i>	(Pai-Keaw (Pijit)			/		H
	<i>Bambusa sp.</i>	Bong-Neaw		/			G
	<i>B. arundinaceae</i>	-			/		H
	<i>B. burmanica</i>	Van-Nan			/		D
	<i>B. glaucescens</i>	(Konkaen)			/		D
	<i>B. longispiculata</i>	-			/		D
	<i>B. nana</i>	-			/		G
	<i>Dendrocalamus asper</i>	Tong-Noo			/		D
	<i>D. asper</i>	Tong-Van			/		H
<i>D. membranaceus</i>	-		/		H		
<i>D. sericeus</i>	-		/		H		
<i>Thyrsostachys oliveri</i>	-		/		D		

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
June 1, 1987.	<i>Rambusa multiplex</i>	-	Bangkok	/		G
June 2, 1987.	<i>Arundinaria suberecta</i>	-	Nakornsritam-maraj		/	H
	<i>Bambusa burmanica</i>	Bong-Van			/	H
	<i>B. ventricosa</i>	-			/	H
	<i>B. vulgaris</i>	Pai-ngachang			/	H
	<i>Dendrocalamus asper</i>	-			/	H
	<i>Melocanna humilis</i>	-			/	H
	<i>Thyrsostachys siamensis</i>	-			/	H
June 12, 1987	<i>Arundinaria suberecta</i>	-	Bangkok		/	D
	<i>Dendrocalamus asper</i>	Tong-Van		/		Do
	<i>Arundinaria suberecta</i>	-	Nakornsritam-maraj		/	H
	<i>Bambusa arundinaceae</i>	-			/	H
	<i>B. flexuosa</i>	-			/	H
	<i>Dendrocalamus asper</i>	Tong-Klai			/	D
	<i>D. asper</i>	-			/	D
	<i>Dinochloa scandens</i>	-			/	H
	<i>Gigantochloa sp.</i>	Pai-kamyam			/	H
	<i>Schizostachyum zollingeri</i>	Pai-Meang			/	H

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
June 22, 1987.	<i>Dendrocalamus giganteus</i>	-	Singapore	/		G
	<i>Phyllostachys aurea</i>	-		/		G
	<i>P. sulphurea</i>	-			/	
	<i>Oxytenanthera albociliata</i>	-	Chiangmai		/	D
	<i>Thyrsostachys siamensis</i>	Rauk-Lek			/	D
	<i>Dendrocalamus asper</i>	Tong-Keaw	Nakornayok	/		Do
June 26, 1987.	<i>Bambusa flexuosa</i>	-	Nakornpathom		/	
	<i>Dendrocalamus membranaceus</i>	(Poo-pae)			/	H
	<i>D. asper</i>	Tong-Keaw	Nakornchaisri		/	
June 30, 1987.	<i>Bambusa flexuosa</i>	-	Chaingmai	/		C
	<i>B. nutans</i>	-			/	D
	<i>Dendrocalamus strictus</i>	-		/		C
July 2, 1987	<i>Rambusa</i> sp.	Pai-Kanomjung	Nakornpathom		/	
	<i>R. arundinaceae</i>	-			/	
	<i>B. burmanica</i>	Bong-Van			/	
	<i>B. flexuosa</i>	-			/	
	<i>B. longispiculata</i>	-			/	

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
	<i>Thyrsostachys siamensis</i>	Rauk-Kao			/	
	<i>T. siamensis</i>	Rauk-Pa		/		
	<i>T. siamensis</i>	Rauk-Raw			/	
July 20, 1987.	<i>Dendrocalamus brandisii</i>	-	Kanchanaburi		/	D
July 25, 1987.	<i>Dendrocalamus asper</i>	-	Kanchanaburi	/		Do
	<i>Melocalamus compactiflorus</i>	-			/	H
	<i>Oxytenanthera albociliata</i>	-			/	D
July 30, 1987.	<i>Arundinaria ciliata</i>	-	Ubonratchanee	/		C
August 19, 1987.	<i>Atatea aztecorum</i>	-	Bangkok		/	
August 25, 1987.	<i>Thyrsostachys siamensis</i>	-	Bangkok	/		C
August 28, 1987.	<i>Dendrocalamus asper</i>	Tong-Dam	Bangkok	/		G
September 2, 1987.	<i>Bambusa longispiculata</i>	-		/		H
	<i>B. tulda</i>	-			/	H
	<i>Dendrocalamus asper</i>	Tong-Dam	Prajinburi		/	H
	<i>D. asper</i>	Tong-Keaw		/		H

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
September 15, 1987.	<i>D. asper</i>	Tong-Noo	Prajinburi		/	H
	<i>D. membranaceus</i>	-			/	H
	<i>D. sericeus</i>	-		/		G, P
	<i>Gigantochloa densa</i>	-			/	H
	<i>Thyrsostachys oliveri</i>	-		/		Do
	<i>T. siamensis</i>	Rauk-Daeng		/		Do
	<i>T. siamensis</i>	Rauk-Van (Tab-Kwang)			/	H
	<i>Bambusa humilis</i>	-			/	H
	<i>B. longispiculata</i>	-		/		G, P
	<i>B. multipler</i>	Sae-Chuan		/		Do
	<i>B. nana</i>	-			/	H
	<i>Dendrocalamus asper</i>	Tong-Keaw			/	H
	<i>D. asper</i>	Tong-Van			/	H
<i>Schizostachym aciculare</i>	-		/	H		
October 5, 1987.	<i>Bambusa nana</i>	-	Narativas		/	H
	<i>Dendrocalamus asper</i>	-			/	H
	<i>D. membranaceus</i>	-			/	H

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
October 6, 1987.	<i>Dendrocalamus latiflorus</i>	-	Nakornpathom	/		G
	<i>D. membranaceus</i>	(Poo-Pac)		/		G, Do
	<i>D. strictus</i>	-		/		P
	<i>Thyrsostachys siamensis</i>	Rauk-Pa		/		G
	<i>T. siamensis</i>	Rauk-Raw		/		G, H
October 16, 1987.	<i>Bambusa multiplex</i>	-	Bangkok	/		G
October 19, 1987.	<i>Arundinaria suberecta</i>	-	Chiangmai	/		Do
	<i>Dendrocalamus asper</i>	Tong-Dam		/		G
	<i>Thyrsostachys siamensis</i>	-		/		P
October 26, 1987.	<i>Bambusa burmanica</i>	Van-Nan	Chiangmai	/		G
	<i>Bambusa multiplex variegatus</i>	-		/		G
	<i>B. nana</i>	Pai-Kanrom		/		G
	<i>Dendrocalamus brandisii</i>	Pai-Sangyen	/		P	
	<i>Gigantochloa densa</i>	-	Kanchanaburi	/		H, P
	<i>Dendrocalamus asper</i>	-	Rachaburi	/		Do, C
October 30, 1987.	<i>Arundinaria suberecta</i>	-	Songkla	/		G
	<i>Bambusa sp.</i>	[ Dam-Kwan (Konkaen)			/	

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>		
				Survive	death			
November 16, 1987.	<i>B. arundinaceae</i>	[Pai-Pajang (Lampang)	Chiangmai	/		C		
	<i>B. arundinaceae</i>	(Narativas)		/		C		
	<i>B. blumeana</i>	[Bong-Ban (Lampoon)			/			
	<i>E. spinosa</i>	Pai-Nam		/		C		
	<i>Cephalostachyum virgatum</i>	(Lampoon)				/		
	<i>Dendrocalamus asper</i>	Tong-Dam				/		
	<i>D. hamiltonii</i>	(Chaiyapoom)				/		
	<i>D. tulda</i>	[Bong-Dam (Pijit)				/		
	<i>Gigantochloa sp.</i>	Pai-Kabdam				/		
	<i>G. apus</i>	Pai-Takwang		/			G	
	<i>G. auriculata</i>	-		/			C	
	<i>G. densa</i>	(Prai)				/		
	<i>G. nigrociliata</i>	[Pai-Loa (Chiangrai)				/		
	<i>Melocanna humilis</i>	Pai-Bangjang				/		
	<i>Schizostachyum aciculare</i>	(Narativas)				/		
	<i>S. brachycladium</i>	(Pattalung)				/		
	<i>Thyrsostachys siamensis</i>	Rauk-Yai				/		
		<i>Bambusa vulgaris</i>		(Doi-Sutep)			/	
		<i>Dendrocalamus asper</i>		Tong-Dam			/	H

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
November 20, 1987.	<i>Oxytenanthera albociliata</i>	-			/	
	<i>Phyllostachys nigra</i>	(Doi-sutep)			/	
	<i>Thyrsostachys siamensis</i>	(Doi-sutep)		/		G
	<i>Cephalostachyum pergracile</i>	-	Bangkok	/		G
	<i>Bambusa flexuosa</i>	-	Ayudtaya	/		G
December 9, 1987.	<i>B. nana</i>	Pai-Peng		/		G
	<i>Thyrsostachys siamensis</i>	-			/	
	<i>Dendrocalamus sp.</i>	Pai-Maju	Bangkok		/	
	<i>Dendrocalamus sp.</i>	Pai-Lewju			/	
	<i>Phyllostachys sulphurea</i>	-			/	
December 14, 1987.	<i>Arundinaria pusilla</i>	-	Konkaen	/		G
	<i>B. glaucescens</i>	-		/		
	<i>B. nana</i>	Pai-Van		/		
	<i>B. ventricosa</i>	-		/		
	<i>Dendrocalamus asper</i>	Tong-Van		/		
	<i>D. asper</i>	-		/		
	<i>Bambusa sp.</i>	Dam-Kwan	Buriram	/		
	<i>B. vulgaris</i>	-		/		

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
December 17, 1987.	<i>B. blumeana</i>	-	Bangkok	/		
	<i>B. burmanica</i>	-		/		
	<i>B. glaucescens</i>	-		/		
	<i>Dendrocalamus asper</i>	Tong-Moa		/		
	<i>D. asper</i>	Tong-Dam		/		
	<i>D. strictus</i>	-		/		
	<i>Bambusa</i> sp.	[Pai-Lai (Petchaboon)		/		
	<i>B. burmanica</i>	Pai-Van		/		C, H
	<i>B. multiplex variegatus</i>	-		/		G
	<i>B. nana</i>	Pai-Kanrom		/		
	<i>B. ventricosa variegatus</i>	-		/		H
	<i>Cephalostachyum pergracile</i>	-		/		Do
	<i>C. virgatum</i>	-		/		
	<i>Dendrocalamus</i> sp.	[Pai-Nang Nuan (Chachengzao)		/		G
	<i>Dendrocalamus</i> sp.	Pai-Keemod		/		P
	<i>D. asper</i>	Tong-Keaw		/		Do
	<i>Phyllostachys sulphurea</i>	-		/		Do
	<i>Schizostachyum aciculare</i>	-		/		Do
<i>S. aciculare variegatus</i>	-	/		H		
<i>Thyrsostachys oliveri</i>	-	/		Do		

Table 6. (Cont'd.)

Date of collection	Species	Clones	Places of collection	Status incultures		Comments <sup>1/</sup>
				survive	death	
December 23, 1987.	<i>Bambusa sp.</i>	Pai-Kama	Petchaboon	/		G
	<i>Dendrocalamus sp.</i>	Pai-Kabdaeng		/		
	<i>Dinochloa scandens</i>	-		/		H, P
	<i>Phyllostachys sulphurea</i>	1		/		P
	<i>P. sulphurea</i>	2 (Kao-Ko)		/		
	<i>Thyrsostachys siamensis</i>	Rauk-Lek		/		
December 30, 1987.	<i>Bambusa sp.</i>	Pai-Keaw	Kanchanaburi	/		
	<i>Gigantochloa hasskarliana</i>	-		/		
	<i>Dendrocalamus asper</i>	-	Nakornchai-sri	/		

- <sup>1/</sup> = Comments  
 C = Callus formation  
 D = All died  
 Do = Dormant  
 G = Growing  
 H = Heavy contamination  
 P = Partially died

V. FUTURE WORK PLAN (JANUARY - OCTOBER, 1988)

1. TECHNOLOGY DEVELOPMENT.

1.1 Stem-bud segments system.

- continue experiments on multiplication and transplanting of several bamboo species.
- continue study the effect of low temperature and growth retardants on conservation, and evaluate the subsequent effects of growth retardants after conservation.
- Cryo-preservation experiments.

1.2 Leaf callus system.

- Continue experiment on regeneration of several bamboo species.

2. GERMPLASM COLLECTION.

- continue to collect bamboo species in Thailand.
- establish cultures of bamboos those have not been existed.
- collection of bamboos from Sri Lanka.

3. TRAINING OF COUNTERPART.

- Training of scientists from Sri Lanka is planned around February or March, 1988. Arrangement with Sri Lanka Government is in progress.