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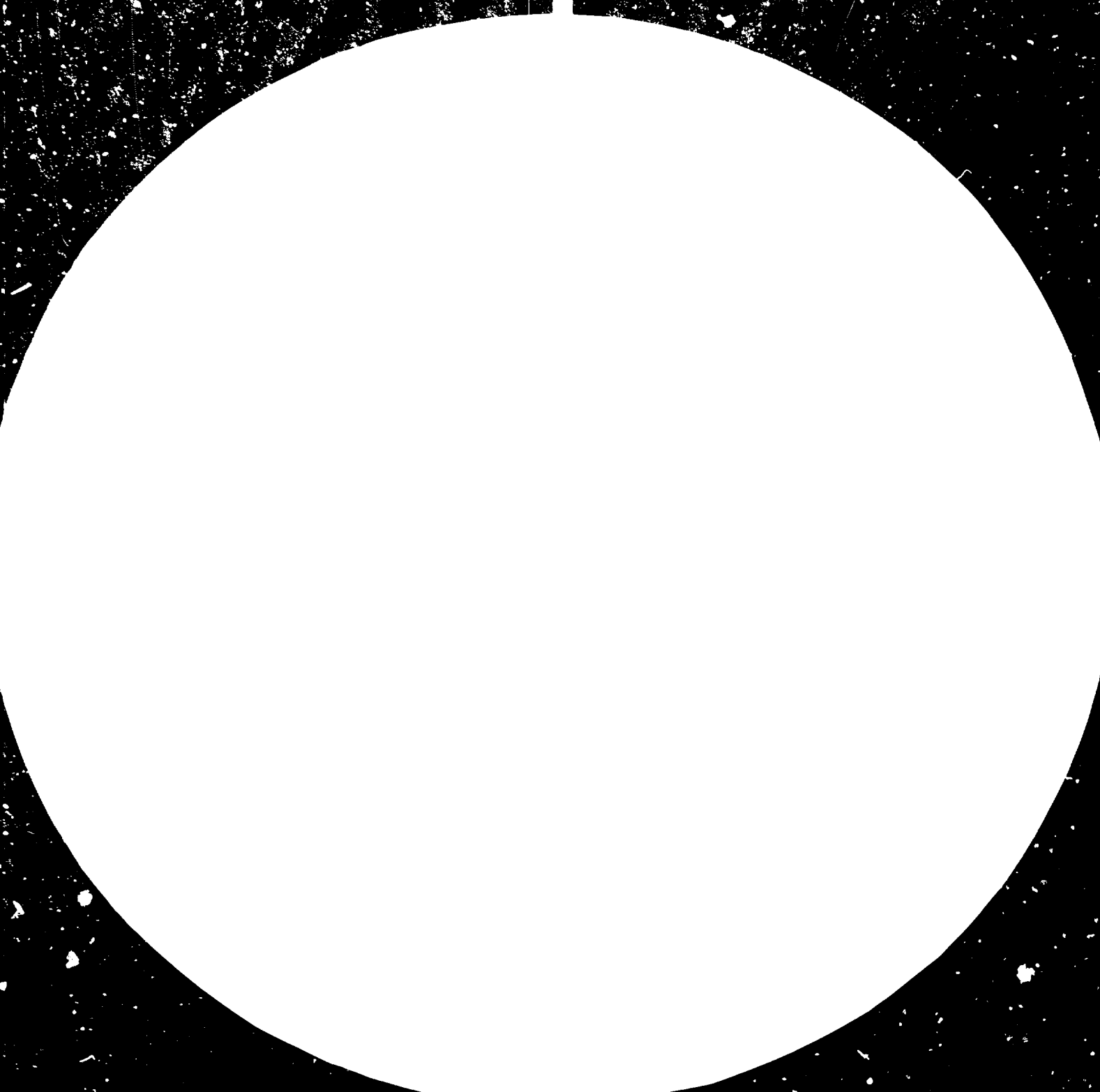
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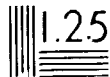
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REVITALIZING THE RAMIE INDUSTRY IN THE PHILIPPINES

SI/PHI/82/801

PHILIPPINES

Technical Report*

Prepared for the Government of the Philippines
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Chien Chu,
Expert in Ramie Processing and Finishing

United Nations Industrial Development Organization
Vienna

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Explanatory notes

Local currency value:	1 Peso (₱) equals \$0.11
Abbreviations	
PTRI	Philippine Textile Research Institute
RAMITEX	Ramie Textiles, Inc.
RAMCOR	Ramcor Farms, San Miguel Corp.

ABSTRACT

The project was to assist the Government of the Philippines in developing a programme for revitalizing the ramie industry in the country. The expert served a period of three months (3) which started September 8, 1982 to December 9, 1982 in cooperation with Mr. Min Li Lai, expert in ramie fiber production. Four (4) organizations coordinated in carrying out the experimental work of the project.

1. The Philippine Textile Research Institute for fiber testing and weaving experiments
2. The Ramie Textiles, Inc. for fiber degumming and processing, testing and fabric finishing experiments
3. The Ramcor Farms of San Miguel Corporation for fiber decortication and integrated degumming experiments
4. The Fil-Fibers Manufacturing, Inc. for weaving experiments

Main Conclusions

1. World clamor for natural fibers prodded ramie growers to expand ramie hectareage for more export of crude ramie fiber due to its rising price. It is opportune to modernize fiber production techniques for higher yield and better quality, which can be attained by degumming ramie in the green state. Production of degummed fiber in ramie growing areas should be promoted.
2. Experimental demonstration of fiber extraction with Corona decorticator integrated with fresh degumming produced bleached fiber of high quality with good tensile strength as compared to the

degummed fiber by conventional fermentation-chemical degumming.

3. Preliminary spinning tests in the United States and Netherlands for twistless ramie yarn from the ramie rovings of RAMITEX showed good smoothness and high luster as compared with the conventional ring spinning which produces hairy, twisted ramie yarns.

4. Weaving and finishing tests with silk filament as warp and twistless coverspun ramie yarn as weft produced high quality fabric which is soft and lustrous. Spun silk folded yarn as warp and ramie coverspun yarn as weft also showed high quality fabric at less cost than that using silk filament as warp.

5. Weaving and finishing tests with cotton folded yarn 40 Nm as warp and coarse, twistless ramie yarn 14 Nm as weft showed good quality of ramie sheeting suitable for pants and jeans. Slack mercerization was done on the finishing tests.

6. New twistless ramie yarn without polyester blend simplified fabric finishing process by eliminating singeing, brushing and heat-setting and improves softness and crease resistance.

Recommendations

Revitalizing the ramie industry in the Philippines can be achieved in ten (10) directions:

1. Production of high quality degummed fiber for processing by improved fiber extraction and in-line degumming of fresh fiber will enhance fiber quality and increase farm profit. World price of bleached ramie fiber is in the order of \$2.5/kg (₱22/kg) f.o.b. One hectare of ramie with six (6) crops can produce 1.5 - 2.0 tons of bleached fiber with a total value of \$3,750 to \$5,000. Most degumming chemicals can be used for fertilization by returning the waste degumming liquor to the field through an irrigation system.

2. Mechanical harvesting and field ribboning of ramie should be developed to produce stapled fiber at less cost. Ramie harvester

and ribboner should be designed, constructed and tested to fit into a long range project. Stationary or portable decorticators are too heavy and expensive in power and labor demands. Simple ribboners should replace Raspadors for less labor and higher yield of fiber.

3. Improvement of fiber processing by using stapled ramie fiber to make combed ramie tops will extend the market of ramie fiber to many textile mills in the Philippines.

4. Modernization of spinning for ramie fiber and its blends will improve yarn quality characterized by smoothness and high luster. This will simplify fabric finishing by eliminating singeing and brushing.

5. Distinctive quality of ramie with respect to luster and strength can be enhanced by making fine, twistless yarn such as cover-spun yarn as weft and spun silk or silk filament as warp. This will also save warp sizing. A combination of ramie and silk can be developed suitable for the barong tagalog, the Philippine national costume for men.

6. Coarse, twistless pure ramie yarn as weft with cotton yarn as warp can produce fabrics for household linens and pants with good crease resistance and soft handle by slack mercerization in finishing. This will cost less than the ramie/polyester blended fabrics.

7. Research facilities at PTRI should be strengthened by acquiring fiber degumming equipment featuring pressure digester.

8. PTRI should have a simple machine shop to design and construct fiber extraction machinery.

9. For long range ramie processing research, PTRI should have a pilot plant for ramie twistless spinning and ramie composite yarn.

10. Coordination of ramie and coconut industry featuring intercropping of ramie with coconut trees should be developed. This will afford use of coconut wastes as fuel for ramie degumming in farms. Also coconut oil can be used as softening agent for degummed fiber.

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INTRODUCTION

1. The realities and myths of ramie

Ramie as a beautiful silky textiles fiber originated in China has tantalized promoters and investors in the world for more than 150 years. Ramie is still an under-exploited textile fiber in the world. In several developing countries such as Brazil, the Philippines and China, ramie has remained as a small grower's crop which produces crude fiber known as China grass. The crude fiber consists of rather stiff, greenish-yellow fiber two to five feet long.

In 1940-1950, most early ramie promoters in the United States and Central American were fascinated by the high agricultural production of ramie with three to six crops per annum. Most investors on ramie crop failed due to insufficient knowledge on fiber extraction and processing. Numerous patents on ramie decorticators were filed but none achieved commercial application. Others claimed miraculous degumming processes for extraction of ramie fiber. Yet, little value has ever been added to the ramie development. Literature on ramie research is also very scarce.

In Brazil, ramie acreage reached a peak over 50,000 hectares in early 1970's mainly for export to Japan but production dropped soon and only less than 2,000 hectares remained. Partially degummed ramie has been used as blends with jute to make fine cordage yarn by the jute spinning system.

In the Philippines, ramie faced a similar situation with a peak of 4,000 hectares in 1955 but dropped in recent years to only 210 hectares in 1977. Now, production revived to 1,200 hectares.

Ramie is the bast fiber produced from the tall stingless nettle plant Boehmeria nivea. The plant is native to Southwestern China but grows luxuriously in any warm temperate and tropical climate with plenty of rainfall. It is a perennial plant and once grown in proper soil and environment will yield as much as six crops a year. The stalks, with leafy top, can attain a height

of five to eight feet. The ramie fiber does not lend itself to the water retting process, which is usually applicable to other bast fibers such as jute and kenaf. The degummed fiber yield is approximately 2% of the weight of the green plants. Hence, there is a large amount of waste in ramie fiber extraction.

The degummed ramie is a multiple-celled, long bast fiber, differing from the other fibers in that the ultimate cells are considerably longer and thicker. The ultimate cells are 3/4 - 20 inches long and 20-70 μ in diameter. The fiber is coarser near the base of the stalks. The fineness of the fiber varies from 4 to 6 denier. The cellulose elements are arranged in spirals in the cell wall causing the fiber to turn clockwise when moistened and allowed to dry. All other common textile fibers except flax turn counter-clockwise. Degummed ramie consists of nearly pure cellulose, analysis showing 99.2% cellulose in a sample of purified ramie. As a bast fiber, ramie is superior to all other bast fibers in strength and versatility.

Ramie forage constitutes about 40% of green ramie plant. It is well-known for its high value as animal feed and is superior to alfalfa hay.

Ramie shive amounts to about 70% of dry ramie stalk. It is a waste from extraction of ramie bast fiber but can be used to grow mushroom or to make compost preferably with cattle manure.

With six crops a year in the Philippines, one hectare of ramie can produce about 2-2.5 tons of crude fiber or 1.5-2 tons of degummed fiber, 4.5 tons of shive and 4 tons of leaves all on dry basis.

World production of ramie was estimated at 130,000 tons in 1975 by Tropical Institute of England. China accounted for production of 100,000 tons of crude fiber per annum in 1981.

The poor cohesive spinning quality of ramie fiber in ring spinning and the wrinkle character of ramie fabric impel extensive

use of synthetic fiber such as polyester and acrylic fibers as carriers especially for fine yarns. The amount of synthetic fiber in ramie blends usually is in the range of 65 to 75 percent. The ramie-polyester yarn produced by ring spinning is hairy, which requires brushing, singeing and heat setting in fabric finishing. The finished fabric often has burned pills and coarse handle unless properly softened. Eventually, the cost of ramie-polyester fabric is much higher than say cotton-polyester fabric.

Although ramie fabric is characterized by its durability, it also has some poor qualities like brittleness and abrasion which spoil ramie market for garment. Thus fabric structure should be designed and composite yarn should be formulated to minimize the shortcomings of ramie.

2. Project background

The Philippine ramie industry was started in 1930 and reached a peak production of 5,500 metric tons in 1965 with exportation of 4,500 metric tons in 1964. The ramie industry declined since the middle of 1960 and dropped to 396 metric tons in 1977. Production revived to a small extent in recent years. Due to competitive crops and high production cost of crude ramie fiber, the ramie industry encountered unstable supply of fiber and rising fiber cost.

There were two operational ramie textile mills in 1966, i.e., Ramie Textiles, Inc. (RAMITEX) and the Davao Ramie Textiles, Inc. (DARATEX). The latter sold the mill facilities to RAMITEX and got into production of palm oil. RAMITEX has expanded steadily to 24,000 spindles with integrated weaving and finishing.

Although exports of ramie slivers, combed ramie tops and ramie yarn as shoe laces showed some growth in recent years, the domestic market of ramie fabrics which are usually of various blends encountered market stagnation. The ramie-polyester fabrics are coarse and rough due to singeing operation which produces burnt fiber ends. Also, the price of ramie-polyester fabric is about 30% higher than blends of cotton-polyester.

The Philippine Textile Research Institute (PTRI) has excellent fiber and fabric testing equipment. The Institute has been active in cotton spinning research with a cotton spinning pilot plant. In recent years, extensive work has been done on sericulture development. Marketing silk for export and domestic consumption is very limited due to the high cost and some quality problems.

The Philippines has the appropriate climatic, social and economic conditions necessary for the revitalization of the ramie industry. The textile industry in the Philippines comprising of 172 textile mills utilizes cotton and synthetic fibers as raw materials. Ramie fiber is used only by RAMITEX.

3. Official Arrangements

The request for United Nations assistance was initiated by Dr. Ricardo C. Cruz, retired director of PTRI, and endorsed by the National Science and Technology Authority to UNIDO in early 1980. The project was approved in November, 1981 and became operational in June, 1982 under the SIS funding of UNIDO, which required two ramie experts for a three month mission. Dr. Chien Chu, ramie processing expert started September 8, 1982 whereas Mr. Min Li Lai, ramie production adviser started October 1, 1982.

The cooperating agency was the Philippine Textile Research Institute assisted by Ramie Textiles, Inc. The Ramor Farms of San Miguel Corporation also rendered assistance for fiber production.

4. Contributions

UNIDO contribution was:

Project personnel		1982
Experts on	m/m	
1. Ramie Production	1/3	\$ 15,600
2. Ramie processing and finishing	1/3	15,600
Official travel	2/3	<u>3,200</u>
Total		\$ 34,400

Project Fellowships (including airfare)		1983
a. Ramie processing	1/3	\$ 9,000
b. Ramie finishing	1/3	<u>9,000</u>
UNIDO total contribution		\$ 52,000
Government contribution in kind (in Pesos)		1982
Counterpart personnel		₱ 21,751
Facilities		15,000
Sundries		6,000
Miscellaneous		<u>9,180</u>
Total		₱ 51,931
Counterpart contribution in kind by		
Private sector (in Philippine pesos)		1982
Counterpart personnel		₱ 10,000
Facilities		6,000
Sundry		<u>3,000</u>
		₱ 19,000

5. Objectives of the project

a) Development objective

The development objective of the project is to contribute to the attainment of the national development objectives of the Philippine government, which includes the maximization of employment opportunities and income generation, especially in areas where ramie can be grown profitably, dispersal of industrial activities, self-reliance in vital products made from indigenous materials, and import substitution through the manufacture of exportable products.

b) Immediate objective

The immediate objective of the project is to assist the government in the following:

- to identify existing problems and research needs of the local ramie industry;
- to render ad hoc technical advice on the various aspects of ramie production and processing;

- to identify possible areas where further foreign technical assistance (in the form of technical expertise, foreign training and/or equipment) will be required for the revitalization of the ramie industry.

6. Training

Fellowship training for two trainees will be provided by UNIDO. The trainees will receive three months technical training abroad. The expert on ramie processing will advise training programs for the two fellows.

7. Work Plan

- a. Improvement of ramie processing from field harvest to the processing station in coordination with agronomical research.
- b. Production of degummed fiber in the Ramcor fiber extraction plant by experimental demonstration.
- c. Improvement of yarn production in the Ramitex factory by fiber processing tests.
- d. Improvement of weaving and finishing in the Ramitex factory through PTRI research.
- e. Review technical training fellowships for research leaders of PTRI and Ramitex, Inc.
- f. Recommendation for revitalizing the ramie industry in the Philippines.

I. RECOMMENDATIONS

1. Production of degummed ramie fiber integrated with ramie fiber extraction in Davao and with the corona decorticator in Ramcor Farms should be done. San Miguel Corporation and RAMITEX have been informed for appropriate action.
2. Modern twistless spinning process for ramie yarn to reduce hairy surface and to assure higher luster should be adopted. RAMITEX has made preliminary spinning tests for both fine and coarse yarn.
3. Reducing polyester content in ramie blends will facilitate fabric slack mercerization for improved softness. RAMITEX is currently acting in this direction.

4. Extension of fine ramie twistless yarn to local silk weaving industry for silk warp and ramie weft fabric will simplify fabric finishing and provide domestic market with high quality ramie-silk fabric suited for "barong tagalog". PTRI and Fil-Fiber Manufacturing, Inc. have done weaving tests with finishing made at RAMITEX.
5. Production of 100% ramie fabric with medium count (.14-30 Nm) twistless yarn should be developed featuring slack mercerization and soft resin finishing. The fabric will serve well for sheeting and jeans. The production cost can be made competitive with cotton fabric. A cotton warp and ramie weft fabric which is soft resin finished is also good for shirting. PTRI has made weaving tests with finishing done at RAMITEX. Twistless yarn from Netherlands was made with ramie roving from RAMITEX.
6. Production of combed ramie top from stapled ramie fiber at RAMITEX as a basic raw material for blending with other fibers will extend the market for ramie. Innovation of spinning processes for ramie blends should be promoted.
7. PTRI researchers on ramie should be strengthened by adding the following equipment:
 - a. Pressure degumming digester
 - b. Fiber ribboning machine
 - c. Twistless yarn spinning machines of various types
 - d. Warping and sizing equipment
8. As a long range measure, a ramie research center with pilot plant at PTRI should be established to consolidate development and to utilize the result of this project and promote investment in the revitalized ramie industry.

II. OBJECTIVE OF THE PROJECT

a. Job description

Purpose of the project

To assist the government of the Philippines in developing a program for revitalizing the ramie industry in the Philippines.

b. Duties

The expert on ramie fabric processing will be based at the Philippine Textile Research Institute (PTRI). The expert will coordinate his activities with the expert in ramie fiber production. Specifically, he will be expected to:

- 1) Conduct a survey on the research needs of the ramie industry;
- 2) Prepare a program to accelerate the development of the ramie industry in the Philippines;
- 3) Provide technical advice on ramie production and processing to the appropriate government and private counterpart staff;
- 4) Make recommendations and give solution to the existing problems and bottlenecks encountered in the development of the industry.

III. ACTIVITIES

Preliminary survey of research and processing facilities at PTRI and RAMITEX was made. Literature studies were done at PTRI which had prepared many reprints of publications dealing with the ramie industry. Work plan was soon drafted after discussing with counterstaff at PTRI and RAMITEX. Courtesy calls were made at the San Miguel Foundation and the Fil-Fiber Manufacturing, Inc. Inspection trips were conducted to Davao ramie growing areas, ramie baling station, ramie trading firms and Davao Agriculture Experiment Station.

Preliminary degumming tests were made with fresh ramie from RAMITEX by PTRI staff at the RAMITEX laboratory. Physical tests of the degummed fiber were done at PTRI.

Two weeks field work at Ramcor Farms was made for experimental degumming of fresh fiber from both Corona and Raspador machines.

Experimental coverspun twistless fine ramie yarn made in the USA by Leesona Corp. with Ramitex roving was tested for weaving as weft with silk filament, cotton and spun silk as warp separately. Weaving was done at PTRI and Fil-Fibers Manufacturing, Inc. Trial using coverspun twistless fine yarn (72 Nm) for both warp and weft was also made with the use of starch as sizing agent.

Experimental spinning of 100% twistless yarn in Netherlands with RAMITEX roving was conducted in early November, 1982. The twistless pure yarn of 14 Nm was tested for weaving at PTRI and finishing test was made at RAMITEX.

Picañol Corporation, Belgium donated a Picañol shuttleless loom to PTRI. A seminar on Picañol looms on 1 October 1982 was attended with PTRI and RAMITEX staff. RAMITEX has about 100 Picañol shuttle looms in operation.

Various degumming tests with fresh ramie ribbon and fiber softening test with coconut oil emulsion were made at RAMITEX with technical assistance from PTRI.

Emulsion from industrial grade coconut oil showed promise as a substitute for Neo-Ramilon, which is an imported softening agent for ramie fiber.

Decortication on the Corona machine using pre-cooked fresh stalks without leaves was done at Ramcor Farms. A second visit to Ramcor Farms was made on November 3, 1982 with Mr. Ramon H. Davila, President of RAMITEX; Mr. Aristeo T. Ycasiano, Senior Vice-President and General Mill Manager and Mr. Arturo V. Cucio of San Miguel Corporation. A staff meeting was made to review all current problems and our recommendations at the Ramcor Farms.

As both RAMITEX and Ramcor Farms are subsidiary organizations of San Miguel Corporation, a meeting with the President of San Miguel, Mr. Ernest Kahn, was held on November 15, 1982. Present were Mr. Ramon H. Davila and Mr. Aristeo T. Ycasiano of Ramitex, Ms. Rosario E. Canlas and Ms. Evelyn L. Llamas of PTRI and Mr. Min Li lai, UNIDO expert on ramie fiber production. Samples of fabrics produced from twistless ramie yarn were presented to the President with the brief statement of the expert's views on the Philippine ramie industry. Mr. Kahn expressed keen interest in modernizing the ramie industry with emphasis on growing ramie as intercrop with coconut trees. A visit to the Baguio Sericulture Station of PTRI was made on December 1-3, 1982 to explore the potential development of silk in cooperation with the ramie industry. A spinning and weaving test with ramie noils cotton blends was made at PTRI to explore the market for noils.

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A mill test with about 200 kgs. degummed fiber from Ramcor Farms was conducted at RAMITEX to obtain combed tops and roving for various spinning tests abroad and weaving tests at PIRI. A mill test for finishing ramie-silk fabric was made at RAMITEX on November 29-30, 1982.

IV. ACHIEVEMENT OF IMMEDIATE OBJECTIVES

Ad hoc technical advice on in-line degumming of decorticated fresh ramie fiber was made at the Ramcor Farms during October 12-25, 1982.

Corona decortication had high fiber loss due to feeding of whole stalks with leaves and slim stems of ramie plant. Improvement of Corona operation was made by stripping the leaves and butting the ends. Also, pre-degumming the stalks with 0.5% caustic soda and 0.5% sodium hexametaphosphate at the boil for 5 minutes before corona decortication produced clean fiber with setting at the Corona for RD-2 fibers. Thus, less drastic action with more clearance was allowed on the Corona to reduce fiber loss. A second degumming with the cleaned fiber was made in 1.5% caustic soda and 0.5% sodium hexametaphosphate at the boil for 30 minutes. The degummed fiber was acid washed using 0.5% acetic acid and bleached in 1.5% hydrogen peroxide at pH 9.0 at 70°C for 30 minutes. The bleached fiber was sun dried and softened with oil dressing. Tensile strength test of the bleached fiber by the Bundle Method at RAMITEX showed

33 g/tex.

In-line degumming of Corona decorticated fiber at Ramcor Farms with 1.5% caustic soda and 0.5% sodium hexametaphosphate at the boil for one hour was made. The fiber was washed in 0.5% acetic acid and bleached in 1.5% hydrogen peroxide at pH 9.0 for 30 minutes at 70°C. The bleached fiber was dried and softened in 5% Neo-Ramilon oil. The fiber showed good quality and has a tensile strength 31 g/tex. Two hundred Kgs. of the degummed fiber was prepared and used in the spinning test at RAMITEX. The fiber was stapled to 6" and carded to make a sliver, which was processed through three drawing operations and combed twice with one drawing between the two combings. The combed sliver was further processed into roving after three drawings.

Spinning tests of the roving was made by ring spinning to produce pure ramie yarn of 24 Nm. The card web was tested at RAMITEX and showed comparable results with the standard card web.

The test carding with the stapled degummed fiber showed good fiber recovery above 95%. The card sliver was more compact than the standard card sliver at the mill with manual feeding. Carding with stapled fiber can accommodate automatic feed for more uniform sliver and higher production from the card.

Two types of twistless ramie yarn were tested in weaving and fabric finishing. The smooth twistless yarn was not hairy and more lustrous than the conventional ring spun yarn. The fabric in the loom state was not hairy. The finishing processes were simplified by elimination of singeing and brushing. Test finishing of the ramie-silk fabric at Ramitex proved high quality as shown by the test report. The fabric with cotton warp and 100% twistless ramie weft was soft resin-finished by slack mercerization. This fabric of 100% natural fiber can serve the local market for sheeting and jeans.

Fabric for "barong tagalog" was made from ramie/silk combination featuring fine twistless ramie coverspun 72 Nm as weft and of silk filament or spun silk yarn $\frac{140}{2}$ Nm as warp. The fabric was scoured and soft finished with high quality featuring softness and silky luster. Forty yards of spun silk-ramie fabric were woven at Fil-Fiber Mfg., Inc. and finished at RAMITEX and tested by PTRI for quality data.

Fabric for shirting was made from cover spun twistless ramie yarn 72 Nm for both warp and weft at Fil-Fiber Mfg. Inc. Finishing tests for the fabric was made 70 ends/inch at PTRI. Although warp sizing was not properly made, the fabric handle after finishing appear soft.

As ramie noils constitute about 25 per cent of the fiber from degummed fiber to combed tops; the market of ramie noils has been a problem. Export of noils below the price of cotton has been made at great sacrifice. Spinning tests at PTRI with a blend of 60% mercerized ramie noils and 40% cotton on cotton system to produce 30 Nm yarn showed good quality. A fabric made with 40 Nm

cotton warp and the noil weft at 50 x 50 warp and weft showed good performance with soft handle by resin finishing. Marketing of the ramie noils to local cotton mills can be developed.

Profitable utilization of the noils can be achieved as the fabric of ramie-cotton blends can be competitive against all cotton fabric. Cotton acts as a carrier fiber for ramie noils in spinning, whereas ramie noils give better luster than cotton.

Emulsion of coconut oil was used for softening ramie fiber with good result. This will substitute the imported Neo-Ramilon for fiber softening.

V. FURTHER TECHNICAL ASSISTANCE

1. Further technical assistance is envisaged in mechanical harvesting and ribboning of fresh ramie stalks, so that the leaves and woody shives can be utilized as animal feed and compost fertilizer respectively. These by-products would lower the cost of bast fiber.
2. Extension of the technical assistance was proposed by PTRI on November 18, 1982 in view of the extensive work to be done on spinning tests abroad and weaving and finishing tests to be made at PTRI and RAMITFX. The justification for extension of the ramie project was fully explained in the Annex.
3. For long range technical assistance, establishment of a ramie research center at PTRI is recommended. As PTRI has little experience in ramie technology, foreign expertise will be expedient in the initial stage of planning the center and advising research programs especially in ramie harvesting, ribboning degumming, processing and spinning and finishing. TNO of Netherlands has proposed joint research project with PTRI on ramie twistless spinning with UNIDO support.

VI. UTILIZATION OF PROJECT RESULTS

The in-line degumming of fresh ramie with the existing corona decorticator will be applied soon. A mill spinning test of the new fiber degummed in Ramoor Farms has been made. Apparent advantage of stapled ramie fiber for carding has been demonstrated.

Transfer of some degumming equipment from RAMITEX to Ramcor Farms has been suggested. Factory finishing of ramie-spun silk fabric at RAMITEX was made on November 25, 1982.

Improvement of ramie spinning featuring twistless and covered filament will be stressed by sending two fellowship trainees to the United States and Republic of Korea for training at several research centers on twistless and coverspun spinning and finishing process.

VII. FINDINGS

1. Ramie has been a neglected field in research and development. Production of large ramie stalks of uniform size by adopting wide row spacing with intercrops in ramie cultivation will facilitate ribboning and decortication with less loss as compared with decortivating slim stalks with leaves.
2. With in-line degumming of fresh ramie at the plantation, degumming chemicals containing nitrogen and phosphorus can be applied so that the waste degumming liquor can be returned to the field as fertilizer especially with the existing irrigation system. Ammonia, diammonium phosphate and sodium hexametaphosphate have been tested with good degumming result. These degumming chemicals will save the cost of fertilizers in ramie cultivation.

One example of degumming was as follows:

- 1st step Cook fresh ramie ribbons one hour at 100°C with 10:1 liquid ratio in a solution containing
 - 2% sodium sulfite
 - 1% ammonia
- 2nd step Acid wash in 0.3% hydrochloric acid at room temperature for 15 minutes.
- 3rd step Bleach half hour at 70°C in 0.5% sodium chlorite solution acidified to pH 4.
- 4th step Rinse the fiber for 15 minutes with 0.2% sodium bisulfite acidified to pH 4, wash
- 5th step Centrifuge

6th step Soften the fiber with a cationic softener emulsion 5% concentration for 30 minutes at room temperature.

7th step Centrifuge to remove excess emulsion.

8th step Oven dry at 80°C.

Breaking strength test at PTRI by Flat Bundle Method:

79 g/tex

3. The Philippine climate is more congenial for ramie cultivation than cotton crop. Hence revitalization of ramie can replace cotton in the cotton textile industry and will eliminate cotton dust hazard in cotton mills. The warm climate also favors ramie for clothing with its high durability.
4. The new ramie spinning process featuring twistless and smooth yarns has reduced yarn hairiness and simplified fabric finishing. Coarseness and itchiness of ramie fabrics can be eliminated by slack mercerization and soft finishing.
5. Elimination of polyester in ramie blending and production of composite yarn with filament core or filament wrapping will simplify dyeing with simple direct dyes; reactive dyes or vat dyes instead of the expensive disperse dyes for polyester in two stage dyeing.
6. Industrial uses of ramie products such as shoe thread, sewing thread, marine cord, meat shroud, bed sheeting, table cloth, pillow cases and furnishing fabrics can use coarse and medium counts of twistless pure ramie yarn, which would cost less than yarn of ramie-synthetic blends.
7. Ramie as a long term crop needs a lucrative price for the ramie growers. Intercropping ramie with coconut trees will benefit both ramie and coconut crops. Organization of grower's cooperatives and establishment of field processing and degumming center will enhance quality control and promote utilization of ramie by-products such as leaf meal for animal feed and compost from ramie shives for cultivation of mushroom. The banana mushroom appeared most promising for its good flavor and easy growth in tropical climate. These by-products will lessen the cost of fiber and make ramie cultivation more profitable.

8. Generation of methane gas from compost and animal manure will provide fuel for the degumming plant in the farm. Thus as well-organized ramie processing center can become self-supporting by recycling ramie wastes to the field.
9. The current decortication of ramie fiber with raspador machines is labor intensive and wasteful. The operation with hand feed requires skilled labor with strenuous effort. Ribboning ramie instead of decortication will save labor and power besides less fiber loss. Two designs of ribboners have been introduced to Ramcor Farms. One was based on modified raspador. The other on modified Rolando machine.
10. The operation of corona decorticator at Ramcor Farms with whole leafy stalks incurred large fiber loss. Field observation and preliminary testing showed that the fiber loss could be minimized if the corona is fed with butted and pre-cooked big stalks without leaves. The waste effluent from the corona can be screened with a coarse rotary screen to remove woody shives. The screen will salvage short slim stalks, which can be conveyed to a Rolando machine with stripper roll for continuous removal of the reclaimed fibers.

The pre-cooking of the stalks for a few minutes before feeding to the corona cleaned the stalks from sand and field dirt besides softening the stalks for firm gripping and decortication.

In the field experiment, the pre-cooking was made in a steel trough with degumming solution containing 0.5% caustic soda and 0.5% sodium hexametaphosphate. The cooking time was 5 minutes at boil. The waste liquor had a brown color due to the tannin and gum from the bark of ramie stalks. Heating of the degumming solution was made by direct burning of Ipil-ipil fuelwood under the through. PTRI will explore possible use of ash from ipil-ipil for degumming and subsequent disposal of the waste degumming liquor for ramie fertilizer in view of the high content of potassium carbonate in the ash.

11. Ramcor farms has a water-tube boiler with fuel oil burner. The boiler was used to supply steam at about 10 tons per hour at 200 p.s.i. to a fiber dryer. Since the world oil crisis, the high cost of fuel oil made the steam drying expensive. Sundrying

of crude fiber has been practiced. In the event of in-line degumming in Ramoor, the boiler should be reconditioned with fresh water softener and wood burning furnace instead of the fuel oil burner. The ash from burning ipil-ipil wood contains potassium carbonate, which can be extracted from the ash by simple leaching with water and used in degumming ramie with diammonium phosphate and sodium hexametaphosphate. The waste liquor can be saved and returned to the ramie field through irrigation.

12. Improvement of carding by using stapled fiber will facilitate use of automatic feed instead of the present manual feed of aged long fiber, which is dusty. In-line degummed fiber does not need aging. The improvement will assure more uniform card sliver with mechanical feed. Dust in the card room should be reduced by installing suction hood over the cards with dust and scrubbing cyclone.
13. Improvement of spinning in domestic spinning mills should be made with a view to use ramie slivers and combed tops as blending fibers. Twistless spinning for coarse and medium counts ramie yarn of various blends can be introduced to many spinning mills in the Philippines. Ramie yarn can replace cotton yarn in many kinds of fabrics.
14. Twistless ramie yarn with polyester or silk filaments wrapping will benefit marketing of both silk and ramie as the new filament wrapped ramie twistless yarn has silky luster and strength of ramie. Fabric made of such yarn has smoother surface than that made of the conventional hairy yarn from ring spinning.
15. The practice of manual harvesting with labor wage based on the unit area of 10m x 10m at P3.00 often leaves high stumps which cause new lateral growth from the stumps with slim and stunted stalks. Such stalks often are responsible for the high fiber loss in Corona decortication.
Harvesting and collection on quality and weight basis should be considered and sub-standard stalks. This would save from the efficiency of the corona decorticator.

16. Portable power reaper with long handle could be useful to reduce back breaking strain of manual harvesting and facilitate cutting ramie stalks close to the ground. This will eliminate long stumps and assure new growth from the roots for large stalks.
17. Mechanical harvesting of ramie with sugar cane harvester should be tested to produce cut stalks of 8 inches segments which can be delivered to a fiber separator of disc type. The separator was designed by RAMITEX with detailed drawings and is under construction at the Ramcor Farms. Mechanical harvesting requires proper land preparation to remove stones in ramie field. Sugar cane harvester has topping device to cut ramie leafy tops which can be collected separately for animal feed. The woody shives from the fiber separator can be spread in to field to make compost. Sugar harvester usually has low stump height.
18. A low cost forage harvester for corn can be adopted for ramie harvesting. Such forage harvester has been tested for kenaf harvesting successfully. The forage harvester can cut ramie stalks into 3" segments and delivered to a wagon which can be attached with a disc type fiber separator as for sugar cane harvester. The segments will be fed to the fiber separator to produce stapled ramie ribbons ready for degumming.
19. To facilitate mechanical harvesting, the ramie field can be defoliated by application of weed killers. A separate mechanical topping to precede mechanical harvesting may be considered to save the forage for animal feed. The additional labor cost could be justified when leaves and ramie undergrowth are removed for animal feed leaving only big stalks for subsequent mechanical harvesting. As foliage constitute 40-45 percent of the ramie plant and the undergrowth of short stems makes about 20-30 percent of the ramie stalks, a separate harvesting may remove 50-60 percent of the crop. Direct grazing by hogs with the fresh forage near the harvesting area may save the hauling of forage to a processing station or hog farm.

20. The defoliated stalks can be harvested with a modified rotary-head forage harvester. The modification can be made as follows:

The speed of the cutting rotor is slowed to about 150 r.p.m., all the blades except one or two are removed, and the feed apron chain is sped up so the stalks move through the cutter head fast enough to obtain the desired length of 3" or higher. Shredded stalks of 3" to 6" length are convenient for separation of shives from fiber in a disc type separator. The harvester cutter can also be used for shredding ramie rhizomes for planting. The storage type roots can be culled and used for animal feed.

21. Ramie noils and wastes account for about 30 percent in the processing of degummed fiber into yarn. This noils wastes have very little local market. Spinning tests at PTRI with 60% ramie noils and 40% cotton blends on cotton system featuring ring spinning showed good result. Mercerized ramie noils gave a softer yarn. The yarn 30 Nm was used as warp with 40 Ns cotton warp. The fabric produced had soft handle after resin finishing.
22. Dehydration of ramie leaves with methane gas generated from hog manure in a pilot plant at Ramcor Farms showed good result. Large scale collection of ramie leaves would need a harvester of improved design featuring leave topping and collection. An advanced type ramie harvester was suggested to San Miguel Corporation for construction and testing.
23. Large amount of off grade ramie such as RD-W and reclaimed fiber from Corona decortication have very little market. They should be stapled 3-6 inches and degummed in the farm for processing in local spinning mills with worsted system in blends with polyester, which will improve spinnability of ramie and extend the market of low-grade ramie. Polyester will serve as a carrier for better web/sliver/roving uniformity. Medium count of 30-50 Nm can be made from blends of polyester and stapled ramie.
24. The existing carding and double combing system for fine ramie yarn at RAMITEX seems extensive and wasteful due to high loss of fiber mainly from double combing and carding. Use of spreader gill boxes with stapled fiber, eliminating at least one

combing and change the ring spinning to twistless spinning with high draft would reduce several drawing operations and minimize fiber losses and ^{dust} hazard in the conversion of fiber to yarn.

25. As the ramie fabric serves mainly the domestic market with little purchasing power, fabric design and yarn production could be oriented to reduce cost and simplify finishing operations. Twistless ramie yarn as made by the TNO process in Netherlands can be used for both warp and weft and can eliminate warp sizing, brushing, shearing and singeing. The cost of fabric can be reduced to a large extent to cater for wide domestic market.

A test fabric made of 40 Nm two ply cotton warp at 60 ends per inch and twistless ramie weft 14 Nm at 30 picks per inch was made without warp sizing at PTRI. The fabric was finished at RAMITEX with scouring, bleaching, drying, slack mercerization, acid washing, drying, stretching, soft resin-finishing and calendering. The fabric was pliable and can be piece-dyed. Sheetings and blue jeans are the potential markets. TNO of Netherlands has proposed a long range joint research project for ramie twistless yarn with PTRI.

26. The fine fabric was made from folded spun silk 2 ply yarn 140 Nm as warp at 90 ends per inch and fine coverspun twistless ramie yarn 70 Nm with polyester filament as wrapping at 72 picks per inch. No sizing was required for the warp. simple finishing was applied with only scouring, drying, stretching, soft resin finishing, curing and calendering.

Although spun silk yarn costs higher than polyester yarn, dyeing cost of silk-ramie fabric is lower and quality is better than that of polyester-ramie fabric, with respect to handle and luster. For export, the fine silk-ramie fabric will command a higher price than the ramie-polyester fabric. The silk weaving industry in the Philippines should take the advantage of silk-ramie combination for market development of silk textiles.

27. Ramie fiber lacks cohesion and often needs a carrier fiber to make fine yarn during ring spinning. Polyester and acrylic fibers have been used, PTRI has tested ramie/wool blends on cotton system. Both ramie and wool are stapled to cotton length. RAMITEX tried ramie/polyester blends on cotton system with stapled fibers. Apparently ramie waste fiber from grading can be stapled to 3 inches or longer and degummed for processing on worsted system into tops. The tops can be processed in local spinning mills with polyester blends to make fine yarn. The worsted system will retain longer fiber length than the cotton system. Hence better yarn can be made from a blend of ramie tops from worsted system. High draft twistless spinning can be applied for the ramie/wool or ramie/polyester blends. Spinning tests along this direction should be made.

28. Use of emulsion of coconut oil for fiber softening after in-line degumming showed good result.

Low grade coconut oil could be used as a substitute for Neo-Ramilon, which is imported for softening ramie fiber. The coconut industry has encountered poor world market with low price. Local use of coconut oil such as ramie softening agent will reduce the cost of degummed ramie fiber.

29. Acetate fibers would cost less than any other artificial fibers for ramie blending. The major cost components in acetate fibers are acetic acid and dissolving pulp. The molasses of Philippine sugar industry can be processed into glacial acetic acid by an established fermentation process. Philippine molasses is cheap and very abundant.

30. The acetate-ramie blends are very useful especially for suitings wherein the acetate imparts soft hand, drake, fabric stabilization and wrinkle resistance. Whereas the ramie strengthens wet strength and supplies ironability, moisture and resin pick-up in soft finishing. The blends are readily dyed simultaneously, cross or in one bath by using disperse dyes for the ramie. Spinning, weaving and finishing tests with imported triacetate filament and staple with ramie staple should be made.

VII. ANNEXES

1. International Staff

Dr. Chien Chu, Republic of China, expert in ramie processing technology and fabric finishing, mission period was September 7, 1982 to December 7, 1982.

Mr. Min Li Lai, Republic of China, expert in ramie fiber production, mission period was September 28, 1982 to December 26, 1982.

2. Senior Counterpart Staff

Dr. Eduardo P. Villanueva, Director, Philippine Textile Research Institute (PTRI), Bicutan, Taguig, Metro Manila.

Ms. Cecilia C. Reyes, Chief, Research and Development Division

Ms. Zenaida I. de Guzman, Sc. Research Specialist IV, RDD

Ms. Rosario E. Canlas, Sc. Research Specialist III, RDD

Ms. Evelyn L. Llamas, Sc. Research Specialist I, RDD

Ms. Clarita Chan, Sc. Research Assistant II, RDD

Mr. Aristeo T. Ycasiano, Sr. Vice President and General Mill Manager, Ramie Textiles, Inc. Bagbaguin, Valenzuela, Metro Manila

Ms. Pura G. Urgel, Chief, Quality Control, RAMITEX

Mr. Jur Pal-laya, Engineer, RAMITEX

Mr. Amador C. de Mesa, Plant Manager, Ramcor Farm, San Miguel Corporation

Mr. Solomon C. Ines, Head, Engineering Department, Ramcor Farm, San Miguel Corporation

3. Fellowship Awarded

Name	Field	Place	Duration of Study
Evelyn L. Llamas	Textile finishing	Korea and USA	3 months
Pura G. Urgel	Textile processing	Korea	3 months

4. Brief description of the Philippine Textile Research Institute

The Philippine Textile Research Institute (PTRI) is a government agency created to undertake a comprehensive program of research, experimentation and studies in projects that will contribute to the growth and development of the textile industry.

The Institute is an attached agency of the Ministry of Trade and Industry, and has three technical divisions undertaking activities on research and development; technical assistance and services; processing, consultancy and manpower training.

The institute regularly conducts basic and applied researches for the textile industry as well as undertakes joint projects with other government agencies and the private sector, the results of which will ultimately benefit the textile industry.

The PTRI is devoting its research efforts on the utilization of indigenous fibers and the development and/or improvement of textile products. Research studies on cotton are still continuing to complement the goals set by the Philippine Cotton Corporation. Studies on ramie focus on the development of finishing formulations to improve the quality of the fabric and enable ramie to compete with other natural fibers in the foreign market.

The Institute has been successful in the mechanical production of pineapple fabrics blended with acrylic and polyester. It also spearheads research and development effort towards the utilization of indigenous fibers like abaca, kenaf and coir as well as textile processing and garment industry wastes for non-woven manufacture.

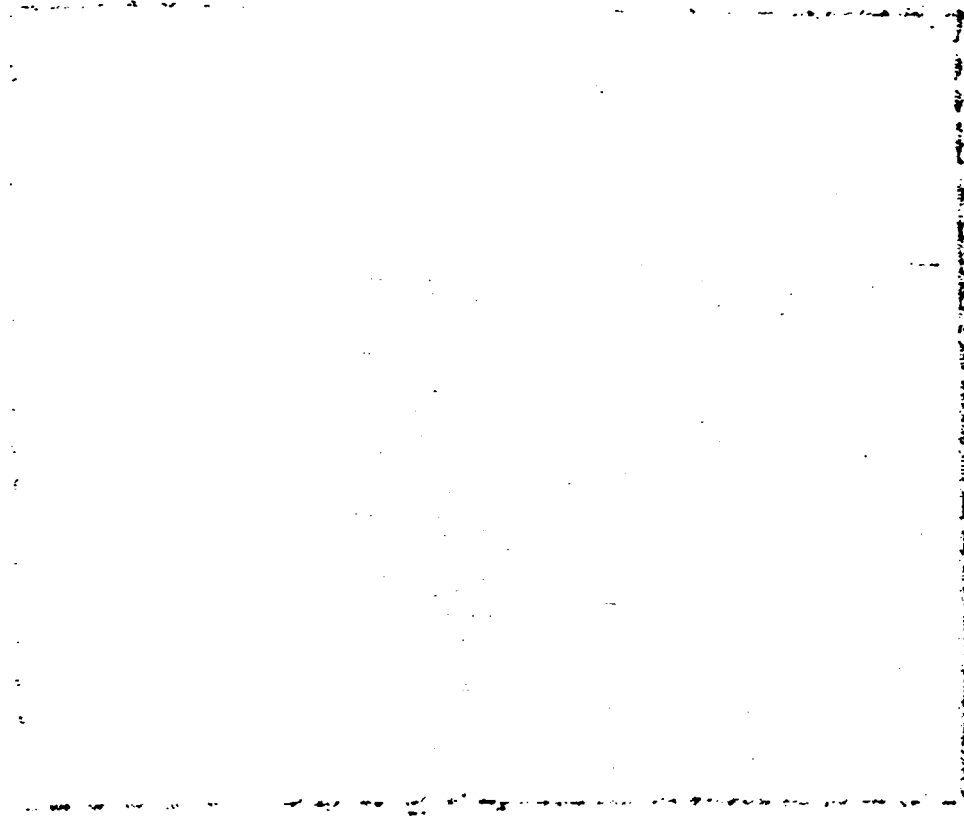
The Institute has likewise succeeded in its campaign on sericulture development - having promoted the interests of small farms and private sector entrepreneurs to engage in this venture.

The Institute is fully equipped with modern instruments capable of making different physical and chemical tests. The laboratory has been chosen as the official testing laboratory in the Philippines by the International Wool Secretariat.

5. References

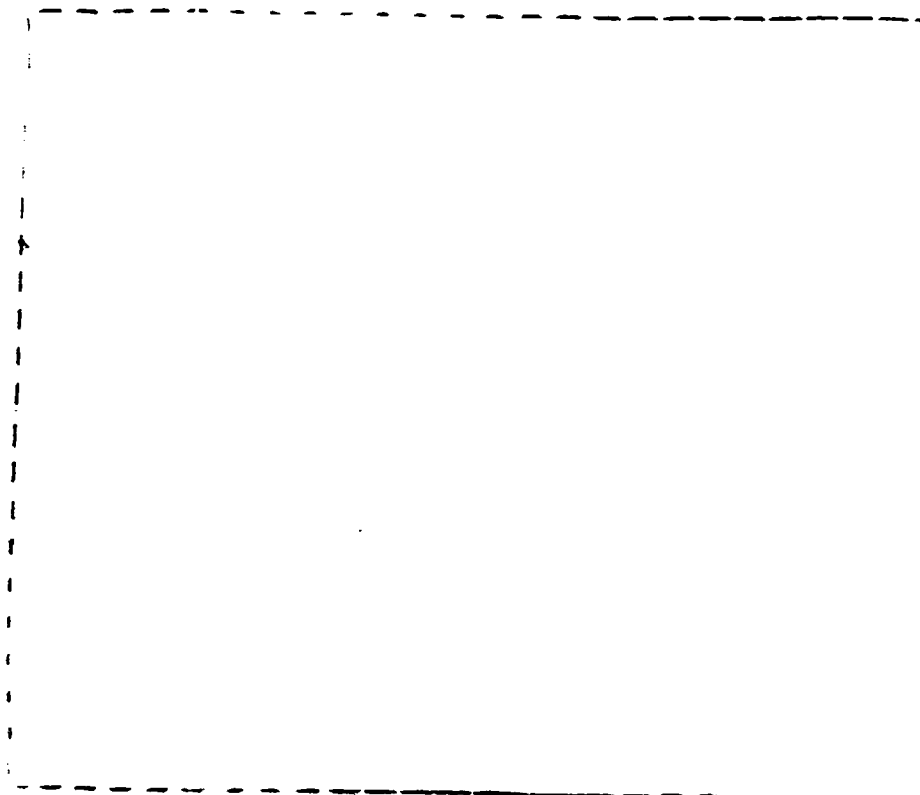
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DATA ON DIFFERENT FABRICS PRODUCED (GREY STATE)



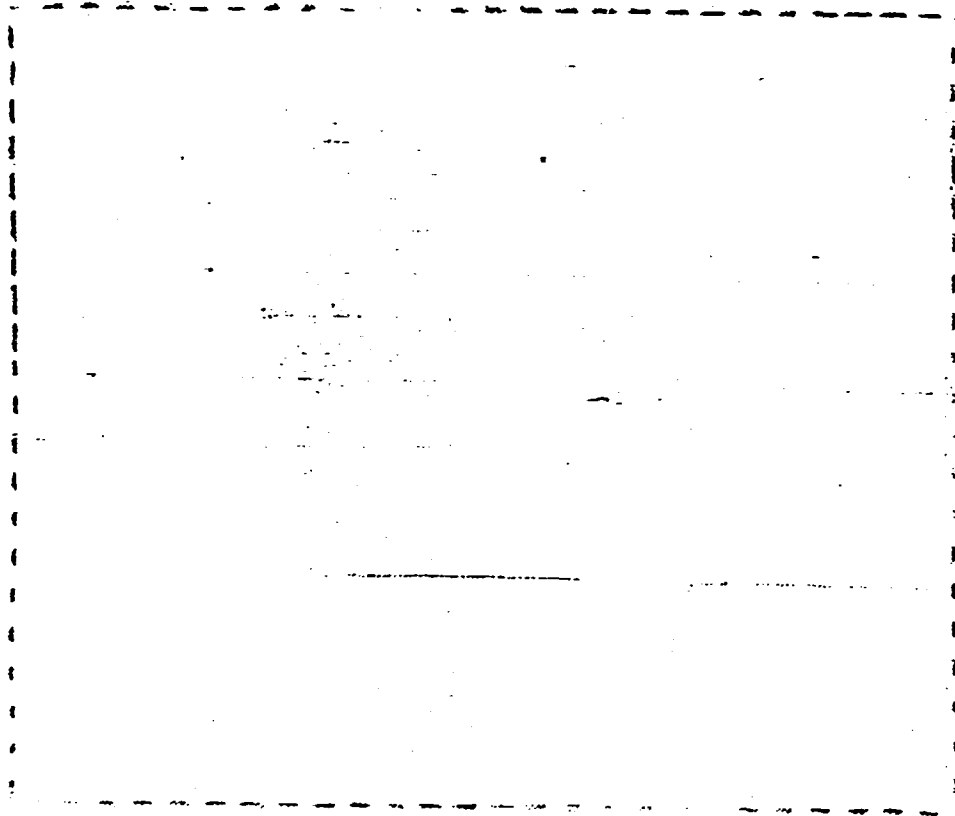
FABRIC A Warp = Spun Silk
Weft = Ramie Coverspun $\frac{17\% \text{ Polyester}}{83\% \text{ Ramie}}$
Construction: $\frac{97 \times 71}{20/2 \times 72 \text{ Nm}} \times 36"$
Weight/Sq. Meter: 94.4 gm/sq. meter

DATA ON DIFFERENT FABRICS PRODUCED (GREY STATE)



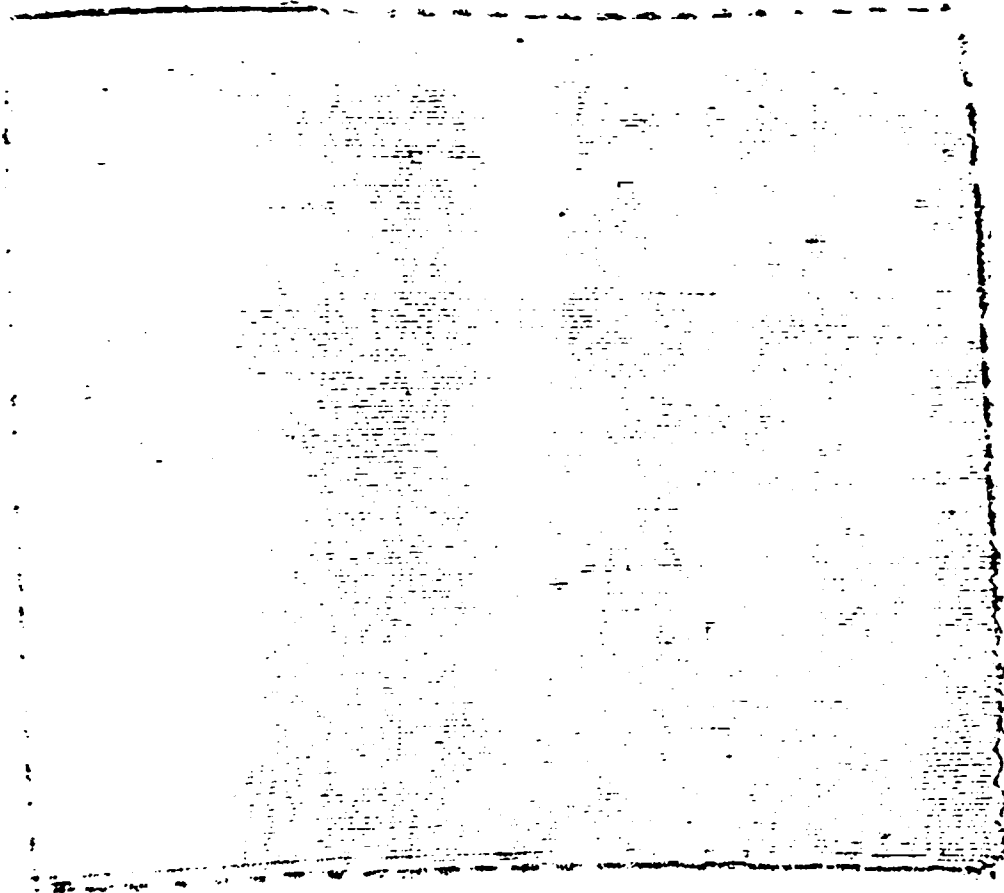
FABRIC B Warp = 100 local silk
Weft = Ramie Coverspun (83% Ramie/17% PE)
Construction: $\frac{120}{20} \times 90 = 42''$
 $\frac{\quad}{2} \times 72 \text{ Nm}$
Weight/ sq. meter: 78 gms/sq. Meter

DATA ON DIFFERENT FABRICS PRODUCED (GREY STATE)



FABRIC C Warp = Ramie Coverspun (83% Ramie/17% PE)
 Weft = Ramie Coverspun (83% Ramie/17% PE)
 Construction: $\frac{95 \times 71}{72 \text{ Nm} \times 72 \text{ Nm}} \times 36''$
 Weight/ sq. meter: 107 gms/sq. meter

DATA ON DIFFERENT FABRICS PRODUCED (GREY STATE)



FABRIC D

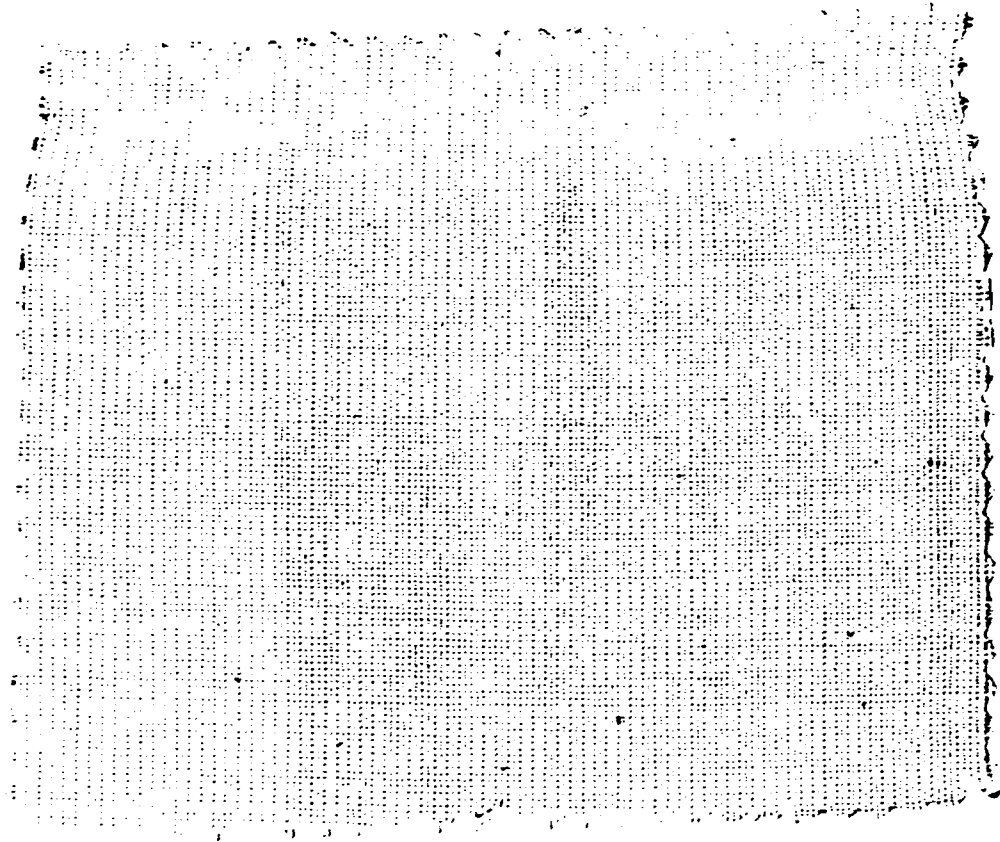
Warp: 100% cotton

Weft: Ramie Coverspun (83% Ramie/17% PE)

Construction: 60 x 84 x 38"
20^s x 72 Nm

Weight/sq. meter: 133 gm/sq. m.

DATA ON DIFFERENT FABRICS PRODUCED (GREY STATE)



FABRIC E

Warp: 100% Cotton
Weft: Ramie TNO Twistless (100% Ramie)

Construction: $\frac{60 \times 30}{20's \times 70 \text{ Tex}}$ x 40 1/2"

Weight/sq. meter: 180/gm/sq. m.



