REPORT ON THE

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MEETINGS OF THE ADMINISTRATIVE COMMITTEE OF THE

INTER-AMERICAN INSTITUTE OF AGRICULTURAL SCIENCES

HELD IN TURRIALBA, COSTA RICA

MARCH 25-28, 1948

Pan American Union
Washington, D. C.

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MEETINGS OF THE ADMINISTRATIVE COMMITTEE OF THE INTER-AMERICAN INSTITUTE OF AGRICULTURAL SCIENCES HELD IN TURRIALBA, COSTA RICA

MARCH 25-28, 1948

The March 1948 meetings of the Administrative Committee were attended by the following:

Members of the Committee

Dr. H. Harold Hume, Provost, College of Agriculture, University of Florida, Gainesville, Florida (Chairman)
Dr. Robert E. Buchanan, Director, Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa
Mr. Mariano Montealegre, President, Instituto de Defensa del Café de Costa Rica, San José, Costa Rica
Dr. Ralph H. Allee, Director of the Institute
Mr. José L. Colom, Secretary of the Institute

Guests Invited to Attend in a Consultative Capacity

Dr. Carlos E. Chardon, Director, Instituto Agrícola Nacional, Ciudad Trujillo, Dominican Republic
Dr. Knowles A. Ryerson, Dean, College of Agriculture, University of California, Davis, California
Dr. Ernest Imle, United States Department of Agriculture Rubber Station at Turrialba, Costa Rica
Dr. Michael H. Langford, United States Department of Agriculture Rubber Station at Turrialba, Costa Rica

Staff Members and Visiting Scientists

Mr. Manuel Elgueta, Chief, Plant Industry Department
Mr. Albert O. Rhoad, Chief, Animal Industry Department
Mr. Norton C. Ives, Chief, Agricultural Engineering Department
Dr. Julio O. Morales, Chief, Department of Agricultural Economics and Rural Life
Mr. Joseph L. Fennell, Horticulturist
Mr. Ernest H. Casseres, Olericulturist
Mr. George F. Bowman, Head of Cacao Program
Mr. Claude R. Kellogg, Interim Staff Member in charge of Vocational Education and Extension Service
Dr. Allan G. Newhall, Visiting Professor in Pathology from Cornell University
Dr. Frederick L. Wellman, Pathologist, United States Department of Agriculture on loan to the Institute
Mr. George M. Slater, Business Manager
Miss Marta Coll-Camalez, Home Economist
Mr. Reed M. Powell, Graduate Assistant, Department of Agricultural Economics and Rural Life
Mr. Jorge León, Analyst

Since the meetings of the Administrative Committee held from November 13 to 15, 1947 thoroughly covered the matters requiring decision, fewer items of administrative importance were considered at the March meetings. Therefore, the Committee concentrated on the progress reports and future plans presented by members of the Institute staff. These reports are attached to the general summary of the meetings indicated below:

Animal Industry

Mr. Albert O. Rhoad, in reporting the work of the Animal Industry Department, announced that an agreement has been reached with the King Ranch of Kingsville, Texas, by which certain research facilities and breeding stock will be supplied. This grant will make possible experimental work in animal climatology under controlled conditions and advance the beef cattle work of the Institute as well as initiate a project in horse breeding. The extensive building program being supervised by Mr. Rhoad in order to increase the animal facilities of the Demonstration Farm has progressed satisfactorily, as have the experiments on the tórsalo (Dermatobia hominus) fly, coffee pulp silage, and the development of a dairy animal for the tropics and similar work on beef cattle, on pastures, and on poultry improvement. The Department should have a competent nutritionist added to its staff during the coming year and a pathologist in the very near future.

Plant Industry

Mr. Manuel Elgueta and staff reported on the considerable advances made in the projects dealing with cacao, coffee, potatoes, sugar cane, and miscellaneous vegetable and food crops. Mr. Elgueta also presented a comprehensive report on his recent studies aimed at determining the role which the Plant Industry Department should play in order to be of maximum service to the member countries. His program within the general policy established

by the Institute emphasizes coordinated work with the Experiment Stations of member countries, the holding of conferences, and the promoting of close relationships between scientists in the field of plant research and development and continuity in the various programs. During the coming year the chief addition to the plant industry projects will be work on corn improvement.

Mr. José Colom, Secretary of the Institute, reported on the work under way in the Inter-American Economic and Social Council of the Pan American Union concerned with basic studies of the situation facing the Hemisphere as concerns vegetable oils and fibers. Since the proposed result of these studies will be the promotion of research and development activities, the Committee agreed that the Institute should offer its facilities to help in carrying these projects forward. It is believed that the research, development, and training activities involved could be concentrated at the Institute even in the cases where actual field work in pilot plants would best be set up in other areas.

It was decided to suggest to the heads of the Experiment Stations of the north central region of the United States that this Institute is interested in maintaining a reserve of potato species in connection with its projects and might also provide a service to the countries of the temperate zone as well as to those of the tropics in this respect.

Agricultural Engineering

Mr. Norton C. Ives reported progress on his drainage, erosion, grain drying, and lumber study projects. The Agricultural Engineering Department is conducting valuable exploratory work and is in a position to expand its program as soon as the necessary funds are available, thus including farm

machinery and structures for the farm with more emphasis on the training of leaders in the application of engineering to farming.

Agricultural Economics and Rural Life

Dr. Julio Morales, assisted by the staff of his Department, reported developments in the Community Study. Plans have been completed for the trial census which it is expected will be taken in August of this year. This census will not only contribute to the studies of the Institute, but is also being carried out cooperatively with the authorities of the Costa Rican Government as preparation for the taking of a complete census in 1950.

The Committee reviewed the work on economics and rural life with particular emphasis on the extent to which the methods developed and the training given will be applicable in the various member countries. It is emphasized that methodology broadly applicable to obtaining a clearer understanding of the human problems of the American countries should be the primary objective. Important recent developments in this Department are the completion of a land use study by Dr. Paul C. Morrison, Professor of Geography of Michigan State College, who has been a temporary member of the Institute staff; the preparation by Dr. Phil S. Eckert, who recently completed six months' work in the Department, of a series of selected readings in Farm Management, which will be translated into Spanish for reference purposes; and the initiation of the joint studies program with Michigan State College, with the arrival of Mr. Reed Powell to serve as sociologist in the Department. Plans have been made to bring Professor W. E. Keepper of Pennsylvania State College to the Institute during the following year to conduct special studies on farm management and land use. Chief emphasis during the coming year will be on the basic socio-economic study of the Turrialba community, the economics of coffee production, and the efficiency of the crude sugar

industry.

Vocational Education and Extension

Mr. Claude R. Kellogg, who is acting for Dr. D. Spencer Hatch, reported on preliminary developments in extension work in the Turrialba region and also extensive preparations for the training of leaders in the vocational education field. Dr. Hatch will make some progress on the development of the Institute's Rural Demonstration Training Center at Noche Buena during the coming year; however, additional funds must be sought for this project.

Library

It was emphasized that special effort should be made to complete the collection of reference material pertaining to the various programs which are being stressed. An effort is being made to obtain all of the pertinent literature available relating to cacao, and bibliographic studies are being made preparatory to completing the library holdings related to coffee. It is recognized that we cannot have all of the library resources which will be required, but the working reference tools necessary should be on hand. Beyond this basic collection it will be necessary to make use of photo-copying devices, periodic visits of members of the staff to library centers, and bibliographic services in the large libraries, such as that of the United States Department of Agriculture in Washington. The library now holds about 10,000 volumes, and it is estimated that 40,000 volumes will be necessary for our purposes. A special effort will be made to obtain further donations of collections.

Teaching Program

The Institute has enrolled eighteen students from eight countries, and it is expected that training facilities will be available for about forty students during the comming year, about half of these being in the specialized project on cacao production. It is expected that twenty-six fellowships will

be available from special grant funds during the coming year, and an effort is being made to find further financial assistance of this kind. The degree to be granted by the Institute was given thorough consideration and it was finally decided to grant the degree Magister Agriculturae, using the Latin phrase so as to avoid the necessity of translating the diploma into the four official languages of the Institute.

Institute Management

Mr. George M. Slater pointed out that whereas the budget for the year 1946-47 was $210,000, for the year 1947-48 it is $466,000. The largest single item in this increase is $133,000 grant of the American International Association for Economic and Social Development. $64,000 was also received from the grants of the Standard Oil Development Company and the American Cocoa Research Committee. The main support of the Institute will always depend upon the quota payments of the member countries, but particularly in the early days, while development expenses are heavy, it is essential that the available funds be augmented by substantial grants from outside. It is also recognized that all possible efforts should be made to increase the income from the Institute farm.

It was agreed that the large lagoon area in the center of the Institute property should be drained as soon as possible even if this involves the obtaining of a loan for this purpose.

The financing of the engineering program was given particular consideration since there is such an urgent need for the development in this strategic field. Attached is a description of the project which has been drawn up in an effort to obtain special funds for the engineering program from a private foundation.

International Conferences

Several international conferences were considered, and it was agreed that Director Allee and Mr. Elgueta should attend the International Forestry Conference to be held in Teresopolis, Brazil, from April 19 to 30 and that Dr. Allee should accept the invitation of the Pan American Union to serve as its representative at this conference. Director Allee and Mr. Elgueta will also go to the UNESCO (United Nations Educational, Scientific and Cultural Organization) Conference for the Establishment of the International Institute of Hylean Amazon which will convene in Iquitos, Peru, on April 30. They will at this time also pay brief visits to the countries of southern South America. The Nutrition Conference to be convened by the Food and Agricultural Organization of the United Nations at Montevideo in July 1948 was recognized as of outstanding importance, but it was suggested that Dr. Fred Soper of the Pan American Sanitary Bureau might be asked to represent the Institute at this Conference. The Institute has been asked to send Manuel Elgueta to the World Genetics Conference in Stockholm during July 1948, and A. O. Rhoad has also been asked to attend this Conference as well as that on Animal Breeding in Milan. The Committee feels that conferences of this nature must be attended by staff members at their own expense.

There has been under consideration for some time a plan to call a conference in Turrialba of Directors of Agriculture and Directors of Experiment Stations, probably beginning with representatives from the Central American area. There has been a considerable demand for such a conference but it is felt that too many other activities are scheduled for the near future to make this possible before the next meeting of the Administrative Committee in September 1948.

PROGRESS REPORT

ANIMAL INDUSTRY DEPARTMENT

A. O. Rhoad

CONSTRUCTION AND ANIMAL PROGRAM

The major portion of the year's work in the Animal Industry Department revolved around the construction of animal facilities on the Demonstration Farm made possible through the grant of the American International Association for Economics and Social Development (See report on page 10). Since December 31, 1947, the date of the last report, the construction program and the purchase of animals have progressed satisfactorily as follows:

Eleven additional dairy cows have been purchased and are on hand. Five Brown Swiss cows and one bull have been negotiated and would have been on hand except for unexpected delays.

Ten purebred Brahman heifers and one bull calf were purchased and are on hand.

Poultry have been ordered and should be on hand within a month.

The swine unit is about completed. The purchase of swine must await arrival of water pipe.

Corrals and calf units have been placed in operation.

The creamery building has progressed satisfactorily. Work, however, has been stopped and will continue as soon as equipment arrives. Equipment for the creamery has been ordered for some time.

Two additional areas have been enclosed in pasture; another is being prepared.

The construction of a residence for the manager of the Demonstration Farm has been initiated.

The power line to the Department is now under construction.

New Grants for Construction

I am happy to report that successful negotiations have been made with the King Ranch of Texas making possible the construction and stocking of a horse unit and the construction and equipping of a climatology or environmental laboratory (See tentative agreement on page 12).

Scientific Program

Experimental work on the control of external parasites, especially the tórsalo, is progressing satisfactorily. A high pressure (400 lb.) sprayer would be of great assistance in this work. Also it should be possible to

obtain technical assistance from some one or more of the industrial companies for this program. The work with coffee pulp silage is being continued. The beef cattle breeding program is progressing satisfactorily.

The dairy cattle breeding program has been hampered for lack of a bull or bulls for this work. Use has been made of a neighbor's bull, and a Brown Swiss bull has been purchased but is not on hand for reasons given above.

Of considerable potential importance is the pending agreement with the Government of Venezuela to give technical assistance in their C Campo dairy cattle breeding program (see attached letter). In the same category is the pending agreement with the Government of the Dominican Republic to assist in developing their animal program at the Instituto Nacional de Agronomía now under construction.

Invitations have been received and accepted (tentatively) to present papers before the Eighth World's Genetics Congress which is to meet in Stockholm, Sweden from July 7 to 14, and the First International Congress of Physiology and Pathology of Animal Reproduction to be held in Milan, Italy, from June 23 to 30, 1948. For the meeting in Milan a paper entitled "Breed Differences in Adaptability to Tropical Climates" has been prepared. For the Stockholm meeting a demonstration on the "Genesis and Genetics of the Santa Gertrudis Breed of Beef Cattle" is being prepared.

International Cooperation

The Department head has been invited to judge livestock at the National Expositions at Chiriquí, Panama, on March 17-21, and at Havana, Cuba, on April 1-5; and also to address the cattlemen of Florida on April 16.

The Department is also assisting the Food and Agriculture Organization in getting together a central catalogue of superior breeding stock and a monograph on pasture and forages.

PERSONNEL

The Department is severely handicapped by the lack of additional technical assistance. A scientist trained in animal nutrition is badly needed not only for laboratory work (see King Ranch Grant) but also to act as head of the Department in the absence of the Chief. Every effort must be made to fill this post. The responsibilities of the Chief have increased greatly with the development of the Department and requests for services that require considerable traveling. A responsible assistant would contribute greatly to the administration of the Department.

A practicing veterinarian must also be added. The capital investment in livestock will exceed $25,000 in another year, and these animals in addition to the observation on tórsalo control that would be placed under his care merit creation of this position.

Sr. Romano Orlich, assistant in the Department, took leave without pay. It is believed that he will not return since his leave of absence terminated on March 6. A graduate of the Escuela Agrícola Panamericana has been hired as flock master for the poultry unit. He is to arrive on March 24.

SECOND PROGRESS REPORT ON DEVELOPMENT PROGRAM UNDER THE AMERICAN INTERNATIONAL ASSOCIATION GRANT

SECOND QUARTER

September 1 to December 31, 1947

I am happy to report continued progress in developing the animal program for the second quarter, September 1 to December 31, 1947, under the American International Association agreement. Although certain phases of the construction program are behind schedule because of difficulties in obtaining essential materials in the United States, other phases are ahead of schedule. It appears at this writing that the construction and animal purchase phases will be terminated on schedule. Also all sections should be in operation on schedule, with the exception of the creamery, which will be delayed because of late shipping dates on much of the equipment.

At the end of the second quarter the poultry unit is ready to receive birds, and orders have been placed with the Washington office for the purchase of the initial flocks. The arrival of birds is expected in the near future. Some provisional arrangements will have to be made as certain poultry equipment ordered several months ago has not yet arrived.

The purchase of dairy cows has progressed on schedule. There are now 26 cows on hand, of which 16 are in production. At this writing 140 pounds of milk are being produced daily from 16 cows, or an average of 15 pounds per cow per day, which is considered good production in this area. Except for the five pure-bred Holstein Friesian heifers, all others are local type criollo cows.

A calf shelter has been constructed and placed in operation, although the calf pens and yards have yet to be completed. The beef cattle corrals, including loafing pens for dairy cows are about three-fourths completed. This structure which includes cattle scales, spraying chute and forage preparation floor is in use. It is anticipated that in another month it will be in full operation. Near the corrals, four medium size trench silos have been built, one of which is now filled with coffee pulp silage.

The main section of the swine unit has been completed but has not been placed in operation due to late arrival of fencing from the United States; water pipes have not yet arrived. Hog pastures and runs have been laid out and sown and are now ready for the construction of fences, the material for which arrived in December. It is anticipated that this swine unit will be

placed in operation within the current quarter.

The construction of the creamery is now about two-thirds completed. Because of unavoidable delays in obtaining creamery plant equipment the construction work will be stopped as soon as the roof is put on and the completion deferred until later. In the interval the building crew will start other more urgent construction work.

Plans are now completed for the construction of a residence, an abattoir, an implement shed, and the erection of a quonset hut. Lack of some critical materials has delayed the construction of power line from the generators near the main building to the Animal Industry Department. Poles have been made and the necessary wire is on hand but the lack of insulators and transformers is delaying its construction.

Pasture development has progressed favorably during the last quarter. Four areas totaling sixty hectares have been sown to improved grasses. This includes four hectares of grasses for soilage crops, which are now producing forage for the dairy herd. Considerable areas have been prepared for fencing. Actual fencing has not started, however, as the barbed wire arrived from the United States in December.

Four hectares of grain sorghums have been planted for livestock feed. Another area of seven hectares has been planted to a cover crop as a soil improving practice. This area will later produce feed for the livestock.

As indicated in the first report all construction and improving operations going on in the Animal Industry part of the Demonstration Farm are under the direct supervision of A. O. Rhoad, Head of the Department. He is assisted in this work by two Costa Ricans and also consults with the Engineering Department of the Institute on many detail matters in connection with the construction program. At the present time thirty-two men are employed in the construction program under the American International Association grant.

AGREEMENT BETWEEN THE INSTITUTE AND THE
KING RANCH

KING RANCH of Kingsville, Texas hereby gives to the Inter-American Institute of Agricultural Sciences, organized by a Convention between the American Republics including the United States, this gift to be used by said Institute for its work in advancing the development of agricultural sciences in the American Republics in accordance with Article II of the Convention.

1. The sum of twenty thousand dollars ($20,000.00) in United States money for the development of research facilities in animal climatology and related fields within the purposes above stated;

2. The sum of thirteen thousand dollars ($13,000.00) in United States money for the construction of a horse barn and paddocks and for the purchase of such breeding stock as said Institute may deem advisable in connection with its said purposes.

EXECUTED IN DUPLICATE.

_____
R. H. Allee
Inter-American Institute of
Agricultural Sciences

Date:_____

KING RANCH

By_____
Robert J. Kleberg, Jr.,
President

Date:_____

REPORT ON THE O CAMPO CATTLE

Caracas, Venezuela, S. A.
December 19, 1947

To His Excellency
The Minister of Agriculture and Animal Husbandry
Caracas, Venezuela, S. A.

Having been invited by the Minister of Agriculture of Venezuela to visit that country and give an opinion on the O Campo cattle and to develop an organization plan that would guarantee the continuation of this meritorious zootechnical work, I take pleasure in presenting the following report:

After a visit to the O Campo Hacienda where I had the opportunity to examine the entire herd, my opinion of the O Campo cattle as basic material for producing a type adaptable to warm climates did not differ from my previous opinion. I believe that, for a mixed Indian-European cattle there does not exist another equal to it in the Americas and I reaffirm the opinion expressed in my previous report, that it would be lamentable to lose the opportunity of carrying out this work which has been so well initiated and is of great significance for the tropical world.

Concerning the genetic value of this herd, there are several points that ought to be taken into consideration: First, for type and milking capacity the herd is exceptional for cattle of this kind; second, the work has already been well advanced both as regards genetic development and as regards the necessary time invested to arrive at the final result of the program--a tropical milch type; third, although there are records of production and the genealogy of many of the specimens, there is much to be desired in order to make these records complete, particularly with reference to the genealogy; fourth, although the reproducing animals were very well selected, there is not a sufficient number of them to carry out the necessary program; fifth, there are a limited number of specimens which are not of O Campo origin as well as others of an inferior breed that should not be used in the program.

For the reasons mentioned before, the genetic value of the O Campo cattle, although very much superior to any other of its kind, does not fulfill the necessary conditions for an ideal type. This should be considered in the determination of a just monetary value. For purebred animals, the monetary value is fixed at approximately two to two and a half times the value of ordinary cattle. Certainly the O Campo cattle have a value equal to that of purebred imported cattle.

Meanwhile it is necessary to keep the O Campo cattle intact in order to obtain their maximum genetic value. By all means the existing herd and the future herd should be guaranteed in order that there may be continued success in a work of this kind. The continuity of the herd

and the continuity of the improvement program are the major points for the success of the work.

In regard to the possibility of transporting the herd to the Institute at Maracay, my opinion is that we should leave it where it is or at least in the same region for the following reasons: First, for the purposes of instruction and experimentation in Maracay, the Institute will need several kinds of cattle and several breeds of each class, and consequently there would be little room at Maracay for the O Campo herd; second, for the purpose of increasing the milk production under the jurisdiction of the State of Miranda, it would be advantageous to keep the herd where it is now; third, the region in the State of Miranda where the O Campo herd is now, because of its topography will always be a cattle region where land is relatively cheap. The program of land utilization in the State is a factor that should be taken into account when considering the advisability of moving the herd; fourth, the pastures of the O Campo Hacienda support the cattle very well, since the animals are fat and strong, indicating the soils are not deficient.

For the greater efficiency of the improvement work and greater security of continuity, it is recommended that the Government of Venezuela establish a station or farm dedicated exclusively to the work of improving the O Campo cattle.

Several governments have followed this plan with good success. It is sufficient to mention the Livestock Station for the Romo Sinuano cattle in Montería, Colombia, the Nus Livestock Station for the Blanco Orejinegro in Antioquia, also in Colombia, and the Zootechnical Station for the Caracú in São Paulo, Brazil; all devoted exclusively to a special breed of cattle.

With regard to the program of cross-breeding, the various genetic groups existing on the O Campo Hacienda indicate that the so called "Industrial" group must be the basis of the future herd and therefore should be increased in number.

For this purpose, the general cross-breeding program should be as follows:

FEMALES	MALES	OFFSPRING
Industrial	Industrial	Industrial (outcrossed)
O Campo	Zebu	Industrial
O Campo (outcrossed)	Zebu	Industrial
O Campo (backcrossed H)	Zebu	Industrial

Some details of the program have been dealt with in conferences with the technicians of the state. This program permits a certain amplification for making the experimental crosses for the better orientation of the basic program.

With regard to the composition of this International Administrative Committee, the writer, upon the insistance of the rest of the members on the Committee, has accepted the responsibility and honor of presiding over it. The writer accepted this responsibility because he is a staff member of the Inter-American Institute of Agricultural Sciences of which the Government of Venezuela forms an integral part.

Since the program deals with a subject related to the improvement of the food of the Venezuelan people, it is suggested that a representative of the Food and Agriculture Organization of the United Nations be invited to become a member of this International Committee.

I wish to express my most sincere appreciation to His Excellency, Sr. Dr. Eduardo Mendoza, Minister of Agriculture of Venezuela, and to his staff for the many courtesies they have extended to the undersigned.

Albert O. Rhoad
Chief, Animal Industry Department
Inter-American Institute of
Agricultural Sciences

PROGRESS REPORT

PLANT INDUSTRY DEPARTMENT

Manuel Elgueta

ORIENTATION AND PROGRAM PLANS

In planning the program of this Department careful consideration has been given to the scope of the services that the Institute must give to the member countries. From actual knowledge of the work on research extension and education that is being carried out in Latin American countries, we come to the conclusion that there are several aspects in which the Institute can be of great assistance.

In most places the extension and education are given without the assistance of fundamental research. Extension especially is carried out by special services which operate independently. The work of the agents is independent and based on knowledge acquired by simple observation and literary studies. Professional education is also given many times in a dogmatic way without the benefit of actual research.

It is true that there is a tendency to correct these deficiencies but there are many difficulties in doing so. We come to the conclusion then that research is fundamental and that one of our main purposes is to help in the development of sound research programs in the different countries. Our action in this sense can be of tremendous importance.

There is a lack of understanding as to what the main points are in a research program. There is a tendency to give primary importance to problems in which the solution will take a long time and will be also out of proportion to the time and energy spent. There is a natural tendency to do the work in the laboratory, but a lack of confidence in real field work. We have seen fertilizer trials in micro plots or even pots not as a complementary study to real field trials, but for their end results in themselves.

There is a tendency also to apply directly all the elaborate North American techniques, which in most cases call for highly trained individuals. It is difficult for a worker in Latin American countries to remain in charge of a technical project through all the years necessary to carry his program to completion. To advance in his profession he has to move from one position to another. His staying in the same position with more or less the same salary seems to indicate lack of ability.

There is also the isolation problem to contemplate. Many stations are in far away places and the staff is not large enough to have more than one man in parallel types of work, with the result that each man must master his own problem because he has no other person to consult or with whom to discuss his work. This results sometimes in work being stopped for small technical details that have to be solved when he is called to central offices.

The organization of research in the Latin American countries shows generally a lack of coordination. Work is grouped under specialized departments which most of the time have antagonistic views toward each other. This results in the worker's specializing in problems without a real broad view of general agricultural problems and not pursuing his objectives in the most effective way.

Programs that are complementary to each other are separated and research cannot have a joint purpose. This prohibits also the possibility of a thorough program so necessary in most cases. Breeding work, for instance, must include consideration of some problems of disease resistance, which calls for the determination of physiological races and also the study of agronomic problems.

Teamwork has not developed in Latin America, not only because of individualism but also because of scarcity of means which makes it necessary for only a few people to be in charge of a wide scope of work. All people cannot appreciate the importance of a special work in the same way. For instance, the problem of physiological races of rust can be of primary importance for the wheat breeder but of secondary importance for the pathologist. The pathologist, in working on this problem, will have to recognize the leadership of the plant breeder. It is natural that he will prefer the problem in which he will be the leader. This problem is so important that I was led to propose a different organization for the Department of the Ministry of Agriculture in Chile, based on a division of function instead of division by specialities.

Many programs are planned by men who know that they will not be in charge of the work for many years with the consequence that they are not careful about details. As an example, we must point out the hybrid corn program. We have seen many wasted efforts because there is a tendency to try to follow exactly the American methodology. There is a real and urgent need for an adapted and simple methodology that can be used in these countries. The work of Wellhausen in Mexico is pointing towards that end.

Corn is only one crop. The same problem arises in each of the other crops. The Institute can take real leadership in this field. We must put emphasis on coordination and we can help here also. Most of the programs are highly specialized and take into consideration only one aspect. In no place have we seen a crop as a central point of the program which considers every problem concerning it. By cooperation we can encourage this type of work. These cooperative programs will also give importance to research in the different countries, and the governments will become more interested in them. We should be able to initiate special meetings for workers in one crop or program. We must be prepared for these meetings by presenting a good program for these crops.

From above discussion we can make some deductions for our orientation. There are several principles which I believe should be followed.

1. Programs should be built around a definite crop so as to cover all the aspects or problems concerned with the crop. Importance should be given to breeding, agronomic trials, phytopathological and entomological studies, and in certain cases even to processing.

2. The whole program must give emphasis to those studies and trials that will permit a formulation of a methodology. For instance, the sugar cane work includes trials on size and shape of plots, border effects, etc. The corn program will give emphasis to the study of new methodology of breeding for use in Latin American countries. Careful consideration will be given to commercial use of top crosses and synthetic varieties for producing with but one or two generations of selfing.

3. Importance should be given to cooperative trials with other countries especially those of new selections or varieties. There are, for instance, new clones of cacao in Colombia, Trinidad, and Costa Rica. An effort should be made to bring all this material together and test it in different regions. We will also have to solve quarantine problems, but an effort should be made to give an international character to our work.

4. Due to the emphasis on thoroughness in each program it will be necessary to formulate programs only on crops for which there is sufficient staff available. We have very limited personnel now, and that is the reason the actual basic program covers only six crops--cacao, coffee, sugar cane, corn, potatoes, and beans. These were selected for the reasons indicated below.

a. Cacao. We have a special endowment for this work. Actual yields are not over 300 kilograms per hectare. It is possible in clonal plantation to get 1500 kilograms per hectare.

b. Coffee. This is the most important crop in at least seven countries, and it is the basis for export and foreign exchange which is of such importance to non-industrialized countries. There are also great possibilities for improvements. Average yields are not over 800 kilograms per hectare, but there are already plantations with average yield of 2,000 kilograms per hectare. Besides, the cultivation of this crop has many problems, such as shade, pruning, fertilizers, etc., that have not been studied.

c. Sugar Cane. It is true that there has been important work done on this crop in Barbados, Puerto Rico and the United States. However, very little has been done in the Latin American countries where sugar cane is of great commercial importance. There is a lack of basic research that can be of great importance, and the Institute can easily affect the production of these countries.

d. Corn. This is a staple food of great importance to all the hemisphere. Breeding has made corn a crop of temperate climates, but its origin in Central America indicates a great possibility for its breeding in these countries. Now corn is a very degenerate crop. Development of a simpler methodology can be of great importance in giving it impetus.

e. Potatoes. These are also important to the whole continent. All the equatorial countries have high altitude regions well adapted for potatoes. Our work can be of direct use to these regions.

f. Beans. We have not yet a definite program for lack of personnel. Beans are a basic food for all Latin American countries, and customs, habits, and tradition are so deeply rooted that we visualize tremendous difficulties in introducing substitutes.

TRIALS UNDER WAY AT THE INSTITUTE

A. FERTILIZATION TRIALS

Project No. 82

1. Cowpea trials: Date of sowing : August 1, 1947
   Date of harvest: November 5 and 25, 1947

P was observed to have a very noticeable effect on vegetation of plants; however, the final result did not show significant differences.

2. Sorghum trials: Date of sowing: September 17, 1947
   First harvest : November 8, 1947
   Total harvest : 412.6 kilograms

Highly significant (1%) N and P and interaction P x Ca.
Interaction N x P significant to 1% level.
Second sowing: January 8, 1948
Second harvest: March 9, 1948
Only Ca and P x Ca significant effect at 5% level.

Subproject No. 42a Compost application

1. Cowpea: Date of sowing : August 1, 1947
   Date of harvest: November 5 and 25, 1947

Significant difference of complete formula at 1% level over check. No effect of compost.

2. Sorghum: Date of sowing : September 17, 1947
   Date of harvest: November 8, 1947

No significant effect of compost.
Chemical formulae. Significant effect at 1% level over compost and check.
Second sowing : January 8, 1948
Second harvest: March 9, 1948
Chemical formulae 5% significant over compost but not over check.

Project No. Sweet Corn fertilization

Date of sowing: March 20, 1948
Factorial 135 kilograms per hectare of N, P, and K and 800 of Ca.
Objective: To study absorption of elements. Will be complemented with tissue analysis.

B. SUGAR CANE

Project No. 70

Collection: Date of first sowing: May, 1947
89 specimens from the following countries:

From Costa Rica	62
From Puerto Rico	4
From Palmira (Colombia)	5
From Summit Gardens, Canal Zone	18
	89

The collection comprises varieties of interest for future work. The following species are represented: S. officinarum, S. barberi, S. sinense, S. spontaneum, S. robustum. All varieties are under close observation. The ones of commercial possibilities are being increased to be tested in variety trials.

Project No. 72 Variety trial in Nicoya - Guanacaste
Initiated, April 10, 1947

Project No. 83 Variety trial with and without fertilization

Date of sowing: August 29, 1947. Total period, 52 months. 10 varieties, 2 treatments, 2 times of harvesting (12 and 16 months). A study was made on germination differences due to varieties and treatments. There were significant differences at 1% level between varieties, at 5% level among treatments and interaction, varieties x treatments.

Project No. 95 Maturity trial. Complement of the former. Two blocks reserved for monthly harvesting on 10-24 months.

Project No. 97 Sugar cane fertilization. Cervantes.

To determine effect of fertilizer over some spot on the leaves. No conclusive results.

Project No. 104 Initiated December 22, 1947. To complement former study. Application of N, P, K, Ca and 3 minor elements.

Project No. 68 Sugar cane fertilization. Initiated, January, 1947. Harvested, February, 1948.

This trial was made on two patches of sugar cane of different ages, 8 months and 4 months old. Fertilizers, N, P, and K were applied at the foot of the plants. The results reported correspond to the 8 month old plants. 23 kilograms of P_2O_5 per hectare gave significant increase

in cane over check at 5% level and significance at 1% level on sugar production per hectare over check. The complete formulae gave significance on the 5% level only for sugar production over check.

Seed Production of Varieties: Some exploratory observations were made as a basis for the future breeding program. Several varieties were examined as to the production of fertile pollen. Some crosses were also made to gain ability in this work.

C. COFFEE

Project No. 37 Renovation of old plantation by cultural treatments and fertilizers. Initiated, November, 1946.

This trial combines 8 fertilizer treatments in 3 doses each, with 4 different cultural practices. The first crop was harvested as a uniformity trial and as expected did not give significant differences. The second crop was harvested from August to October, 1947, in 5 different pickings.
Big differences were determined that can be seen in the tables below:

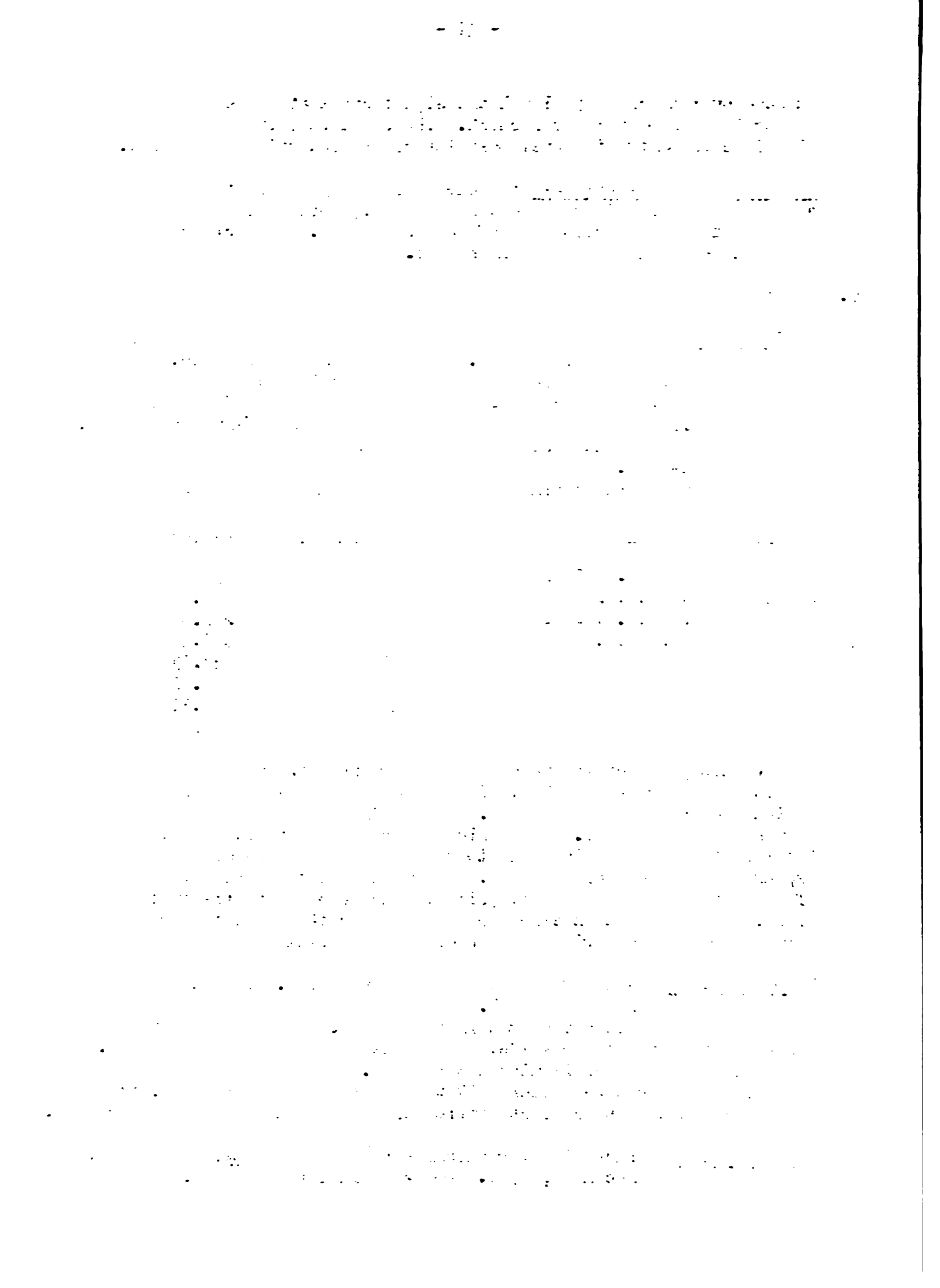
Cultural treatments		Fertilizer treatments	
Shoveling	516.03	N	350.30
Cultivator	559.88	P	333.75
Cover crop	713.10	K	290.35
Weed chopping	683.33	NP	321.53
		NK	332.33
		PK	332.12
		NPK	314.11
		Check	260.21

Unfortunately the differences are not significant. However, it is possible to correct the yield of this trial with analysis of covariance with last year's yield. The coefficient of correlation between both data is 0.28 significant for the 5% level. Examined the results of the individual plots in site we can discover definite explanation for certain results. We can expect that the correction of data by the covariance analysis can increase the accuracy of the trial. As time goes on also the effect of treatments will become more marked and the original plot differences will be equalized.

Project No. 87 Shade effect on an old plantation. Initiated, November, 1947.

This trial has been arranged in split plot. Major treatments are 4 shade intensities: no shade, half normal, normal, and free shade. Minor plots are : fertilizing and pruning. As in the former case the harvest of August-October 1947 was taken as a uniformity trial which will be used to correct future results and increase their accuracy.

Project No. 99 Factorial fertilizer trial in old finca. Initiated, December, 1947. 16 treatments in 2 blocks.



Project No. 42c Compost in old finca. Initiated, December, 1947. Related to the former by the check and complete formulae.

Project No. 86 Effect of transplanting two stages of seedlings, "Copita" and "Arvejon" under 3 different shades. Initiated, June, 1947. Several countings have been made. Final counting will be made in June, 1948, taking number of plants and growth. The effect of shade is very clear.

Project No. 42b Compost in nursery beds to see effect on: (1) germination, (2) vigor, and (3) disease under shade and no shade. Initiated, September, 1947. No effect of compost on germination. After 5 months a count was made uprooting 5 rows from the 10 of each plot, counting the plants, weighing them with and without root, and measuring them. No significant difference was found between compost and checks. These countings were made in plots under shade. The others were in too poor condition for data of germination and loss of plants.

Project No. 93 Collection of varieties and species. Material has been brought to form a collection for breeding purposes. Small trees of the species Canefora, robusta, stenofila, and excelse has been planted. Also trees of different varieties of arabica. A selection was made on the Montecristo Finca of about 70 genetically different trees, and cuttings of each were brought for vegetative propagation. Most of them are rooting.

Seed from San Salvador of the Coffee Nacional, Maragocype and Blue Mountain are being germinated.

D. FORAGE PLANTS

1. Introduction From August 1946 up to now 266 plants from different agricultural institutions have been received making a total of 253 introductions. The most important groups of the last month are of the genus Theobroma, from Brazil and Colombia. There are also several bamboos from Puerto Rico and many legume forage plants from several countries. There is also a collection of shade trees brought from Brazil.

The register has also been improved, with a card for each species on which are noted origin, technical name, use, etc. The card has space for observation on growth, fruiting, disease, etc. There is an indication also for the worker or section who will be in charge of propagating the species. There is an alphabetical list with a number and the letter IIP.

Most of the ornamental plants have been grouped in a small arboretum.

2. Collection of grasses and leguminous forages. We have now 78 plots with 31 species of graminea belonging to the most important grasses of the tropics. There are also about 60 species of leguminous plants for cover crop and forage. There are observations on growth and date of cutting.

E. COMPOST ELABORATION

Project No. 42 Indore process of compost elaboration. Initiated, June, 1947.
Several piles are in preparation. Some have already been used in the different trials. Compost elaboration cost is about ₡ 8.80 per ton.

Analyses have been made with the following results which show a great uniformity:

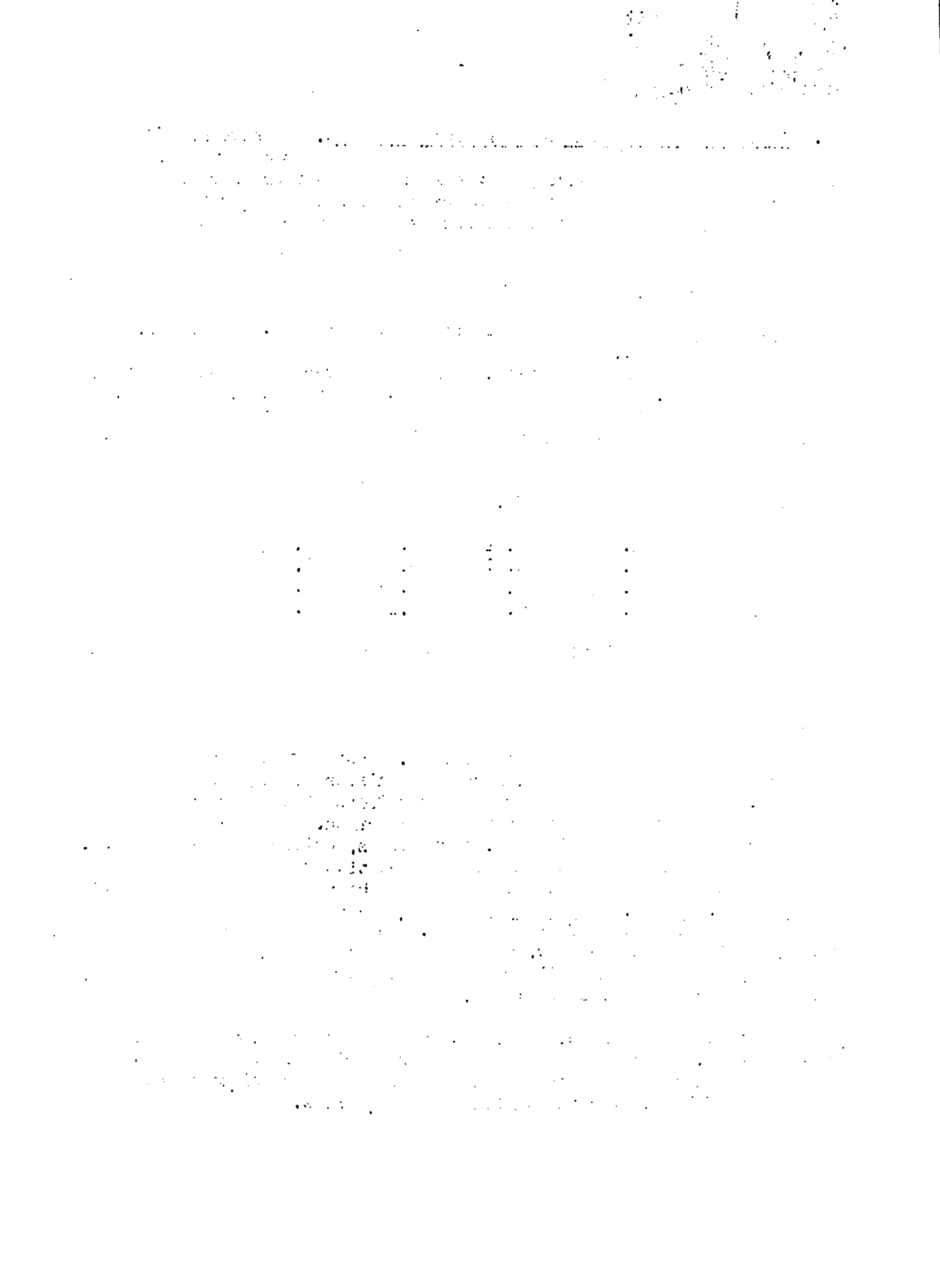
Sample	Moisture	No. %	K_2O	P_2O_5
1	43.53	0.31	0.11	0.43
2	47.83	0.37	0.13	0.35
3	47.67	0.34	0.13	0.39
4	51.65	0.32	0.14	0.32

OUTLINE OF FUTURE PROGRAMS

A. COFFEE

There is very little known about coffee. Most of the cultural practices are formed on tradition and they differ greatly from place to place. Pruning systems are radically different here and in Colombia. There is a definite need for experimental knowledge about shade, pruning, planting distance, fertilizers, cultural practices, etc. There is also a lack of knowledge on the relative value of the different varieties and species. There have been no comparative trials with arabica, borbon, and robusta, some of the new hybrid population used on plantations in different places. We need to know their yield potentialities, quality, and disease resistance. All quality studies up to now compare different varieties from different places, which results in lack of real comparisons.

Coffee trees are extremely variable and offer an enormous possibility for selection. There is definite need for studies about vegetative propagation in order to increase the number of clones selected and obtain a useful tool for the utilization of hybrids.



The progress will include also exploration of the method of the possibility of using sexual propagation in the segregation of self-pollinated plants, effect of homocigetization, and possibility of hybrid vigor. We have to study also some way of shortening the cycle period of four years for the generation of a coffee plant.

Project No. 37. Already under way are studies on problems of fertilization, shade, cultural practices in an old finca and in the nursery. The future program includes the following:

1. Collection of varieties and species. Already under way.
2. Variety trials.
3. Collection of shade trees. Already we have in the nursery a good collection which will be planted in blocks of nine trees each on the new finca.
4. Type of shade, pruning, and fertilizer experiments on the new finca. Complementary to the one one under way already. We are planning to have artificial shade from an arbor in order to be able to obtain definite quantitative data on intensity of shade.
5. Factorial fertilizer experiments. Also complementary to the one under way, but with the idea of studying the influence of fertilizer in the development of the plant.
6. Compost fertilization. Complementary also to the one under way and correlated with the former.
7. Planting distances and pruning.
8. Cultural practices. All major cultural practices from this country and others will be compared.
9. Breeding program
   a. Study in vegetative propagation.
   b. Clonal selection. The selection already started on the Montecristo Finca will be done also in other fincas in our search for mother plants of valuable clones. At the Institute we are aiming to have a collection of five trees for each clone to permit a good observation. At first simple observation will be used to discard the inferior ones. Increase by cuttings of the best ones will permit studying them in field trials.
   c. Self pollination of 30 selected trees on our finca will be started this year. Seedlings will be studied in the nursery. By breeding the best seedlings on old trees we will try to explore the possibility of shortening the cycle, as it has been suggested to us by Dr. Pope. Seedlings will be studied for (1) possibility of direct propagation of the best trees, and (2) loss of vigor, segregation and possibility of hybrid vigor in later combination, which will be propagated by cuttings.

B. SUGAR CANE

As in coffee this program has several projects already under way. A future program will give emphasis to studies on experimental techniques.

The following projects are proposed:

1. Variety trials. Complementary to the one already under way, but contemplating only one harvest time and studies for maturity.
2. Factorial fertilizer experiments. N.P.K. in three levels.
3. Factorial fertilizer experiments. N.P.K. and Ca. To study effect and inter-action of calcium.
4. Planting distances and seed quantity.
5. Planting depth.
6. Plot shapes and sizes. One hectare will be planted to be harvested in small units.
7. Border effects. The influence of heavy doses of fertilizers on one row on the neighboring rows.
8. Breeding. We already have data about the varieties that produce seeds under our conditions. Self pollination program will be started to study segregation and loss of vigor.

Cane is a permanent crop but its yields drop rapidly with each ratoon crop. By cultural treatments and better root system it might be possible to maintain high yields through several ratoon crops.

C. CORN

Nothing has been done up to now on this program. We will have a new man, Sr. Mario Gutiérrez, starting in April to work on corn. We are also looking for a person to lead the corn program. The outline program to be developed is give below:

Objectives:

1. The pure line work has produced a reduction in the germ plasm available in corn, while there are still numerous problems to solve and new ones may arise at any moment. Besides, all the American countries offer an enormous wealth of original material which can be of a great importance. Hence, the first objective of the program would be to organize a systematic search for superior germ plasm, utilizing special tests like the one suggested by Stadler to simplify the work.

2. Organization of a collection of sources of germ plasm by establishing conservation gardens and utilizing facilities provided by several countries or institutions. This objective could be attained on a cooperative basis by making agreements with countries or institutions to keep those varieties adapted to special conditions.

3. Little is known as to the nature of disease and insect resistance, but great success has been achieved in different cases. There are certain different types of insect resistance, for instance, which have been found in widely separate geographical localities, like resistance to the corn borer in the United States and to the locust in Argentina. Hence, another definite objective of the program would be

the synthetizing of insect resistance and disease resistance by utilizing the material collected.

4. Great emphasis is placed today on the necessity for a diversified agriculture. Corn is a very plastic material, and its many uses have been demonstrated. Furthermore, genetic work can achieve important results in giving to corn qualities of great economic importance. We can visualize the possibilities of another type of solution for this problem of diversification by increasing the different uses for corn. Work can be done to create types good for: (a) sugar production, (b) edible oils, (c) paper, (d) wax, etc.

5. Hybrid work has reached a very high point of technical quality. However, these methods are expensive and require highly trained personnel. Not all institutions can develop them in all their efficiency, as proved by the little spread that they have had up to now in Latin American countries. There is a definite need for exploration of a simpler methodology which, without attaining the high results of the double crosses, can, however, give other advantages, such as less exclusion of native varieties with loss of genes as a consequence.

6. Finally, there is and will be need for trained personnel for this kind of work. Other objectives of this program would be the training of personnel.

Procedure:

1. Standard pure line work with as wide a basis as possible will be started immediately. Varieties of all Central American countries will be brought to serve as the basis for pure lines. Top crosses will permit early and wide elimination of inferior lines. The main purpose of this work will be to find really superior pure lines with high combining ability.

The best lines will be further improved by convergent improvement and utilized for the obtaining of single and double crosses as well as for tests for gene selections following Stadler's suggestions.

2. A project should be developed to test simple methods of breeding, like the one proposed by Harlan. Careful measurements should be done to prove their actual value in comparison with the double crosses.

3. Garden collections should be established in strategic places. Cuzco, for instance, might be one. These localities will be selected for their climatic conditions that favour the preservation of seed. Simple methods merely to maintain varieties should be developed, such as the establishment of isolated plots of male and female material, and propagation would be obtained by artificial pollination of the female plants.

In certain cases, as soon as methods are developed, a program of gene selection on the material of these collections can be established. If a real good tester is developed in the future, such as the line with complete translocation on which Burnhan is working, the whole gene selection could be done at the Institute.

4. Yield trials should begin as soon as possible to test the value of the hybrid developed by the Institute of Inter-American Affairs. The pure line of these crosses should be secured as far as possible and their combining ability tested first in top crosses and later in a large number of single crosses to investigate their real value and best possibilities of combination.

RESEARCH WITH VEGETABLE CROPS INCLUDING POTATOES

E. H. Casseres

Project No. 39 - STUDIES WITH POTATOES

Carried out mostly in the Cartago Potato Region. Thirty-five one-day trips have been made since July 1, 1947. Two small areas are being rented to us by potato growers.

Solanum tuberosum

A. Subproject No. 1 - Performance study and increase of new improved varieties.

1. The second harvest of 15 late-blight resistant potato lines (Reddick Cornell) made in October 1947, yielded from 1 to 35 pounds of tubers. Best were EV1-2, DAC-1 (now named Placid), DAB-3 (now named Essex).

2. One bushel lots of the most promising lines and a few new ones were ordered and were planted at three locations. These include Placid, Essex, Filmore, Hartford, Cortland, and EV1-2, CZK-7H, DUA-2, FBY-1.

3. Now growing are samples of Pontiac, Sebago, Chippewa, Katahdin and Smooth Rural.

4. Nine lines produced by Stevenson (USDA) have recently been added. They were sent to a government official in Costa Rica in 1945.

B. Subproject No. 2 - Performance study and increase of the common native varieties and wild species.

1. The Estrella, Morada Blanca and Morada Negra, under observation in our small plantings and in farms are the best varieties of Costa Rica in that order. A small test showed they tuberize well in Turrialba and apparently produce the same number of plants as whole seed when grown in the highlands.

2. Samples of the following kinds have been obtained:

Non commercial here	Wild
Chilena	Sample from Escuela Nacional Agrícola, Guatemala
Forastera	Sample from Irazú Volcano region, Costa Rica Solanum longiconicum
Boston	
Holandesa	
Alemana	
Zamorano Red	
Zamorano White	
Guatemala Barcenas	
Guatemala market	
Cachikel, Guatemala	

C. Subproject No. 3 - Improvement of the Estrella variety by clonal selection for high yield and type

Potatoes from one hundred superior plants selected under optimum conditions were recently planted in order to study their production and type.

D. Subproject No. 4 - Storage losses of potatoes due to Phytophthora infestans and other diseases under different conditions

Leader: José Santos Aguirre, Graduate Student Assistant from Mexico, under direction of Dr. Wellman. Measurement of losses by weight and number of tubers at five elevations with laboratory determinations of causal organism. In progress, to serve as thesis.

E. Subproject No. 5 - Virus transmission
(To be carried out cooperatively with Dr. Ernest Imle of the Rubber Station).

The testing of leaf-roll susceptible healthy stocks next to plants known to be infected to study method of virus transmittal or reason for its apparent inability to exist in the high potato areas.

Planting materials were sent by Fernow to Imle to test the finding of Barrus, Smith and Casseres that apparent absence of aphids in cooler highland should make it a suitable place for production of certified or mother stock seed tubers.

Project No. 40 - FERTILIZING VEGETABLE CROPS

A. Subproject No. 1 - Fertilizing Potatoes

Location: Cartago Potato Region

1. Two completed factorial experiments summarized for the 1946-47 Annual Report showed that N and P increased yields significantly while K was ineffective. Two additional experiments are in progress in other areas.

2. A factorial experiment to study the effect of a heavy dose of fertilizer including a minor element, to be compared to a check treatment.

Arrangements have been made with the extension agronomists of the Cartago Office of the Institute of Inter-American Affairs whereby they will set out on several different farms smaller experiments designed by us to obtain data of a greater local value which should fit into our larger study of general fertilizer problems in the tropics.

B. Subproject No. 2 - Fertilizing Sweet Corn

Location: Institute: August 25, 1947. Harvested: December 3, 1947.

Dry corn measured for data. Fertilizers broadcast on plots and worked in. Results: Data being analyzed

C. Subproject No. 3 - Fertilizing Cabbage

Location: Institute: set out: December 8, 1947; Harvested: February 9 to March 11, 1948. Variety, Early Flat Dutch. Data being analyzed.

Project No. 62 - STANDARDIZATION OF NATIVE VEGETABLES (LOCATION: INSTITUTE)

A. Subproject No. 1 - The Formation of Superior True Breeding Lines of Pumpkin (Ayote to Cuburbita sp.) by selfing

1. Different types and qualities appear at the Institute and elsewhere from seed of this popular nutrious vegetable.

2. Twenty-five mature open pollinated ayotes of different size, shape, color and quality were selected. From 17 fruits 125 ayotes once selfed have been produced. From 4 fruits "lines" inbred twice with a total of 15 fruits have been obtained. Seed from 12 additional open pollinated fruits is being planted.

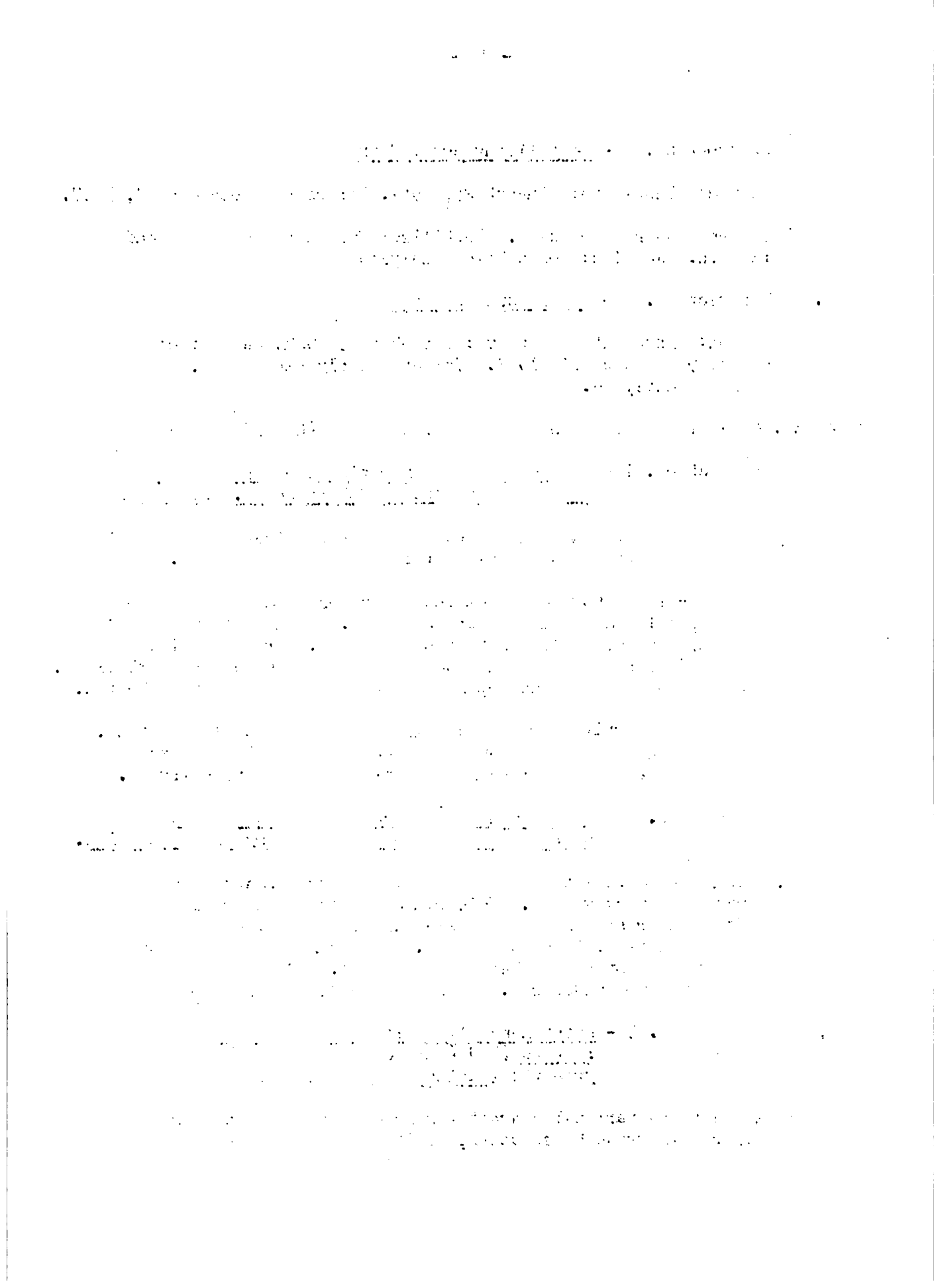
3. The mature fruits now stored, will shortly be cut for testing, cooking quality and replanting of best lines. Notes also taken on production of young "fresh-vegetable" stage fruits.

B. Subproject No. 2 - Improvement of a local pimento type sweet pepper resistant to Cercospora by mass selection.

1. An imported variety like California Wonder, produces one crop and quickly dies. This pimento-shaped pepper is long lived and resistant to the main fungus disease, and although of medium size, is readily sold. Yields record being kept on two 60 foot rows. Mass Selection No. 3 for increased yield, size and type under way. Propose name "Aragón Pimento".

C. Subproject No. 3 - Maintenance of collection of varieties of peppers (10) (Capsicum) chayotes (12) (Sechium) yuca (6) (Manihot) and plantains (2) (Musa).

Yield data and varietal characteristics are taken when possible. Of general interest to students, visitors and for distribution.



D. Subproject No. 4 - Effect of age of cutting, variety and spacing on the yield of yuca (Cassava).

Set out by former student Alfonso Urive and to be sonn completed cooperatively.

Project No. 63 - VARIETY TESTS OF IMPORTED VEGETABLE (LOCATION: INSTITUTE)

A. Subproject No. 1 - Adaptation studies of type varieties of six main vegetables in row planting.

1. Snap Beans. Yields from four bi-monthly plantings during November and December 1947, gave superiority to Tendergreen over Stringless Black Valentine and Refugee US No. 5; to Sure Crop Wax over Pencil Pod Block Wax.

2. Lettuce. Slobolt is vastly superior to Grand Rapids. It is truly non bolting and of high quality. Deer Tongue is the most uniform, grows fast, is of good quality, bolts fairly soon but is desirable. Imperial forty-four heads up a week earlier than Great Lakes but bolts rapidly while the latter has a long harvest period; both quite variable.

3. Cabbage. Early Flat Dutch, best of seven varieties followed by Jersey Queen and Green Acre. Marion Market was very poor. Trial under very adverse conditions. New trial in progress. Also under way is a factorial yield test between the four best varieties.

4. Onions. Of four short-day varieties Early Yellow Globe appears to be the best to date, but all seem very slow in bulb formatioh. All infected with purple blotch, Macrosporium porri.

5. Squash and Pumpkin. Thirty-one varieties listed by Burpee showed marked differences in resistance or tolerance. Bush and all "summer" types succumbed early to mosaic and powdery mildew. Bunner types are maturing some fruit. It appears as a possibility that the native Ayote is highly resistant or tolerant to the aforementioned diseases. Squash borers, Diabrotica beetles and Choanephora, a flower rot, are also important limiting factors.

6. Tomatoes. A factorial experiment to measure yields of Marglobe, Bonny Best, Rutgers and an unknown is under way.

B. Subproject No. 2 - Production of seed from superior plants of known varieties.

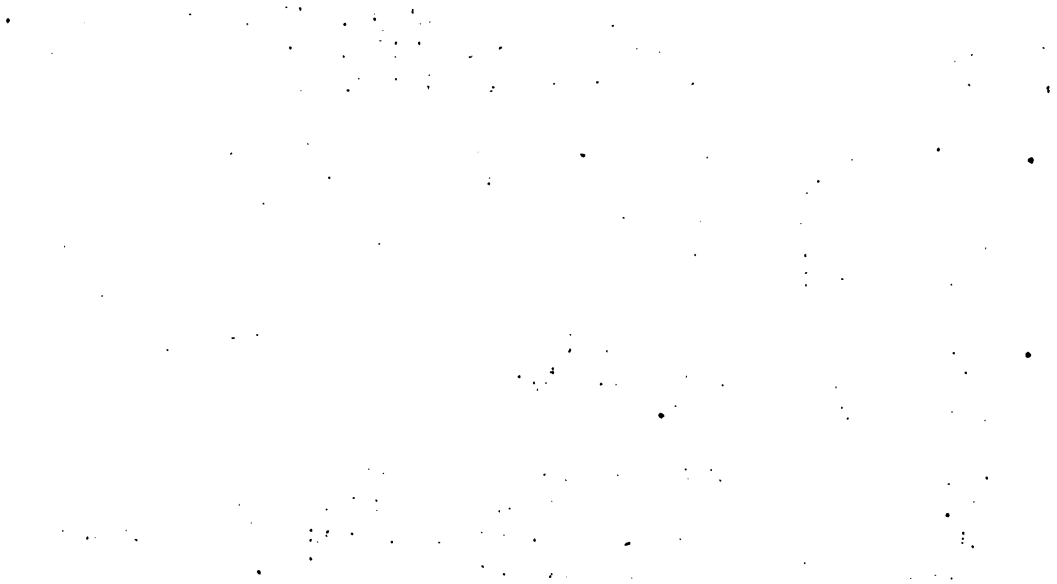
Although varieties which are considered standard in the United States vary little, in several cases when grown under tropical

conditions they appear to vary considerably in their adaptability. To take advantage of such variations, if they are genetic, an effort is being made to produce seed from the better plants.

1. Lettuce seeds freely here. Selected Plants of Imperial 44, Great Lakes, Mignonette and Deer Tongue are now blossoming. Slobolt from the same planting is just beginning to produce a stock. Plants from seed imported from the United States vary in habit.

2. Cabbage of the Early Flat Dutch variety showed a great deal of variation in type. Twenty-six plants have been selected and kept to produce seed.

3. Onion bulbs resistant to pink root fungus were selected by Dr. A. G. Newhall from the Louisiana variety in a commercial planting near San José. Four are stored at 40° F. for three weeks in an effort to secure bolting promptly.



HORTICULTURAL PROJECTS

Joseph L. Fennell

A. TOMATO

Primary Aims

1. Better adaptability to tropical conditions

2. Resistance to late blight, Alternaria, fruit and ground rots, by utilizing wild or primitive types.

Secondary Aims

Resistance to Fusarium, Nematodes, Virus, Leaf Mold, etc., through crossing with improved breeding material developed by other workers.

Progress to date

1. One named variety (Turrialba) that has shown the following superior characteristics as compared to other improved kinds:

    a. Much better adaptability and production under warm or tropical conditions.
    b. Better resistance to Alternaria.
    c. Better resistance to Phytophthora infestins.
    d. Better resistance to ground or fruit rots
    e. Better colored fruit.
    f. Better flavored fruit.
    g. Better textured fruit.

2. Sale of excess fruit

3. One article published; one more now near completion. Seeds of Turrialba lines distributed to many parts of the world. Much interest aroused in this and kindred Institute work.

Work needed

1. Further development and perfection of qualities obtained.

2. Resistance to Fusarium combined with other qualities.

Basic tomato breeding material tested or now growing at the Institute

1. Selections and hybrids of the following species obtained from Experiment Stations in the United States, Hawaii, and Australia:

L. esculentum
L. esculentum Var. carasiforme
L. pimp
L. Peruviranum
L. hirsutum

2. Many improved and primitive garden sorts from the United States and various parts of South and Central America, Hawaii, Australia, South India and Africa.

B. SORGHUM AND CORN

Aims

1. High production and disease resistant varieties of high quality that prosper under both extreme humidity or drought.

2. Seed heads that do not mold, sprout, nor shatter badly in rainy weather.

3. White or colorless varieties with high flour content and superior value for bread, tortillas and cooked cereal.

4. Resistance to diseases, insects and birds.

5. Varieties that ratoon well with succeeding crops and that will produce three to four successive crops from one planting in one year.

Progress made to date

1. Several named varieties developed which show near homozygous growth characters and have production records at Turrialba up to 12,300 pounds per hectare (90 bushels per acre) one crop without fertilizer. (List of some production figures.) Most United States varieties worthless.

2. Much resistance to disease and insect damage.

3. Superior quality and appearance, good palatability.

4. Open head kinds that resist grain molds and rots much better than introduced kinds.

5. One article published; considerable interest aroused; seed distributed upon request to nearly all countries of tropical America as also to Africa, India, Australia, etc.

Breeding materials at Institute

1. Eighteen United States varieties tested.

2. An assortment of wild or primitive kinds.

Corn

Improvement work with corn to test relative promise as compared to sorghum. Better insect resistance, higher production and two or more good ears to the stalk obtained.

C. COWPEA, BEAN, AND SOYBEAN

Aims

Cowpea

1. Higher production and better quality and appearance as an auxiliary substitute for bean.
2. Resistance to humid weather diseases as mildew and leafspot.
3. Better tolerance to virus.
4. Resistance to nematodes.
5. Better resistance to wilt diseases.

Bean

1. Resistance to leaf blight.
2. Resistance to Fusarium .
3. Resistance to leafspot (Phylbsticta).
4. Resistance to stem borers.
5. Resistance to drought.
6. Higher production in all seasons.

Soybean

1. Large seeded edible kind with good adaptability and production in tropics.
2. Less sensitivity to day lengths or seasonal differences.
3. More resistance to molding of mature seeds in wet weather and to shattering in dry weather.
4. Easier cooked dry seeds of better flavor.

Progress made

1. Five or six new and superior varieties of cowpea developed: varieties that have given outstanding yields and promise at Turrialba. These varieties have recieved enthusiastic acceptance in local market tests in competition with beans. Yearly or all season production several times greater than any true bean tested.

2. Large seeds of good appearance and flavor combined with high production.

3. Resistance to mildew.

4. Some improvement in mosaic resistance.

5. Black color, with shape and flavor very suggestive of popular black bean.

6. One article published, two others in process of being published; considerable interest aroused; seeds being widely distributed.

Breeding materials

1. Twenty-five cowpea varieties from the United States together with several more or less primitive selections from Brasil, Peru, Venezuela, Costa Rica, etc., tested.

2. Several wild species studied. More breeding material needed.

D. PEANUTS

Aims

1. Higher production.

2. Freedom from sprouting or rotting in wet ground when mature.

3. Resistance to rust and to Cercospora leafspot.

4. High oil and protein content.

Progress to date

1. Sixteen varieties tested, one or two of which have given very promising results in initial tests. One cross made from which many lines have been selected. The highest production obtained at Institute was given by these new kinds. The nuts do not sprout, although in some seasons there is a rotting problem due to very thin shell. Further breeding needed.

2. One article published on this project, another soon to be published that deals with the peanut and the cowpea.

E. SQUASH AND PUMPKIN

Aims

1. Mature fruit - higher production, better quality and appearance, fewer seeds, medium size, higher vitamin A content.

2. Green Vegetable - higher production, bush or dwarf habit, small size fruits, improved flavor, high seed and mineral content.

Progress to date

1. Three new mature fruit varieties developed from crosses between native ayote and African squash. These varieties have greatly

improved appearance of flesh, rind and form. They are of superior quality and production and are about equally adapted to Turrialba conditions as is the native ayote. Seed cavity is small. Moderately well fixed in fruit characters.

2. Efforts are under way to develop bush types by crossing with Dwarf Pepo kinds and seeming midway kinds from Mexico.

Breeding materials

1. Various primitive selections from Central America, Puerto Rico, Florida, Mexico, India, etc., and improved cultivated kinds from the United States.

2. One article now being published; very favorable comments on limited distributions to date.

F. CITRUS FRUITS

Aims

1. Establishment of a sizable plantation of best available varieties.

2. Study of cultural problems as affecting plant growth and fruit.

3. Study of rootstocks under Turrialba conditions.

4. Collection of best selections available in American tropics.

Progress to date

1. Two hundred twenty-one plants (4 1/2 acres) of eleven best varieties of orange, tangerine, grapefruit and Tangelo established in permanent planting. Some of these varieties have grown well, others only fair. Leaf cutting ants have been a problem. All varieties are grafted on sour orange. A planting of sweet orange seedlings for root stock use is now growing in nursery and should be large enough to bud in about five months.

2. A few additional superior budded varieties are growing in nursery and will be set in the field when weather and growth stage will allow.

G. GRAPES

Aims

1. Development of table and wine varieties adaptable to humid tropics.

2. Adaptability to warm dormant period.

3. Resistance to four most common grape diseases.

4. Large berries, large clusters, good quality and appearance, high and dependable production, long lived vines.

Progress to date

1. Four or five new varieties that have produced well at Turrialba under conditions that no other cultivated varieties have been able to endure successfully. Very limited distributions have been made, although first distribution of these best selections will start this December since material was not previously available. Distributions have been made upon request to Hawaii, California, Mississippi, most countries of tropical America, French Morocco, French West Africa, South Africa, British West Africa, etc. It has been necessary to turn down all personal requests. More world-wide general interest has been aroused by our grape work than by any other food crop project.

2. A population of several thousand new seedling vines now in test vineyard and nursery beds.

3. Several new selections of promise as root stock.

4. Three articles published; one more to appear soon.

Breeding material

1. Superior selections of most tropical and sub-tropical species.

2. Assortment of good breeding parents selected from F and back cross progeny from crosses of tropical species with world's best cultivated sorts.

H. GUAVA

Aims

1. Development of superior fruit varieties with freedom from fruit worms.

2. Establishment of a good collection of best available kinds.

Results

Seedling populations of eight species, and six named varieties of true guava now fruiting. Superior selections of lowest worm susceptibility made and seedling populations now in nursery beds.

I. SOLANUM

Aims

1. Collection of best edible types of the tribe of Solanums to which S. quitense or "naranjilla" belongs.

2. Development from these wild kinds of superior edible varieties.

Results to date

1. Four species of this tribe collected. One form of a little known, perhaps even unknown, species selected and tested for food purposes. Found to be excellent for preserves, pies, etc. Fruit of striking appearance and extensive future possibilities.

2. Inter-specific crosses being attempted.

3. One article (introductory) now ready for publication. Seeds ready for distribution. Effort to determine specific identity or name as new species now under way.

J. AVOCADO

Aims

1. Collection and testing of best tropical American seedling types.

2. Collection of best improved varieties.

3. Acquisition of disease resistant factors for humid climates, with special reference to fruit.

4. Rootstocks that will prosper in wet soils.

Results

1. About one hundred healthy seedling trees now approaching flowering size, all from superior local seedling kinds. It is planned to field graft the named varieties on these as root stocks after their value as fruiting or breeding sorts have been determined. The writer's observation of improved named kinds from Florida, California, etc., is that they are badly attacked by disease in humid tropics.

K. MANGO

Aims

1. Collection of best fruiting kinds.

Results

1. Growth moderately good but conditions are almost impossible for fruiting at Turrialba.

L. MISCELLANEOUS FRUITS AND NUTS

The following kinds are now well established, some are in fruiting stage: Mangosteen, Star apple, Akee, Governors plum, Antidesma, jujube, Canistel, Sour sop, sugar apple, Lichee, Pulisan, Mabolo, Otaheite apple, Surinam cherry, persimmon, plum, blackberry, raspberry, dewberry, etc., White sapote, Ceylon gooseberry, Mammee apple, tamarind, Sapote, Jackfruit, Jambolan plum, Pili nut, tropical chestnut, Tahiti chestnut, Water apple, Nance, Tree tomato, and various others.

M. MISCELLANEOUS SPICE, DRUG OIL AND FIBER PLANTS

Cola nut, Cinnamon, nutmeg, two tung oil species, cocaine plant, betel-nut, quinine, Manila hemp, Cajeput oil, Vanilla, several species of dye plants, etc.

CACAO PROGRAM

George F. Bowman

The program of research for the year 1948 will be restricted by lack of funds, facilities, equipment, and trained personnel, to the investigations that can be conducted at minimum cost and with a minimum of supervision. The training program will be limited by the lack of experience on the part of the students and the dearth of published information on the crop. What we expect or hope to cover before December next is outlined below:

A. STUDENT TRAINING

1. Review of literature -- books, bulletins, and periodicals.

2. Verbal explanations -- unpublished data from experience, plant pathology methods, general.

3. Field work -- observation of work done by United Fruit Company; participation in investigation listed under C.

B. DEMONSTRATION

On La Lola farm fifty acres will be rehabilitated by pruning, cleaning, fertilization, spraying, supplying, and replanting, according to methods I believe best.

C. RESEARCH

1. Plant performance

a. Root studies of mature trees in varied locations, seedlings and cuttings (chupon and fan) at different ages

b. Leaves and stems

(1) Record leaf size in relation to internode length and twig diameter.
(2) Record leaves of seedling and chupon, both natural and cut back to investigate cause of crowning.
(3) Try to induce chupons and affect height of crowning.
(4) Correlate age of wood with flowering.

c. Flowers

(1) Keep record on self-compatible vs. self-incompatible trees, the time of opening, pollen production, abscission, closing of staminodes, etc., in wet, dry, hot, and cold days.
(2) Make insect census of flowers.

d. Fruit

(1) Record maturing period and rate of growth; make volume determinations and weight estimates at weekly intervals.
(2) Determine range of specific gravity in pods of all sizes from different trees or clones
(3) Investigate correlation of cherelle wilt with weather, flushing period, total pod weight increase on tree, flooding, range in pod size.

2. Cultural practices

a. Pruning

(1) Compare production of pruned and unpruned trees.
(2) Correlate terminal growth with fruiting.

b. Fertilizers. Exploratory experiments with N, P, K, and combinations. Effect of excess N, P, K, Ca, B, Cu, Zn, Fe, Mg, M.

3. Propagation. Vegetative.

a. Budding and grafting methods

(1) To increase plant material
(2) To replace old trees by root grafts and inarching at base, rooted and unrooted.

b. Cuttings

(1) Solar propagator; type of cutting; effect of temperature, light, hormones, etc.; leafless cuttings
(2) Constant spray system. Same as above.

4. Disease -- Phytophthora.

a. Investigation

(1) Determine spore concentration in air in various locations under different weather conditions.
(2) Spore population in water drip from pods, stem lesions, wilted chupons.
(3) Determine speed of germination and time required for invasion of pod.
(4) Study protectant value of spray -- cover pod and spray tree; spray pods only.
(5) Compare fungicides by spraying random seedlings and inoculating.
(6) Compare seedlings from resistant trees and susceptible trees by inoculating after spraying.

b. Control methods

(1) Exploratory experiment with spray when pump is received. Bordeaux, Tribasic, Puratized, etc. at 60 day intervals.
(2) Dust, fog, vapor, etc. if machines are donated.

5. Processing

a. Fermentation -- continuous, intermittent, aerated, non-aerated, pasteurized and inoculated, controlled temperatures.
b. Compare results of existing methods.

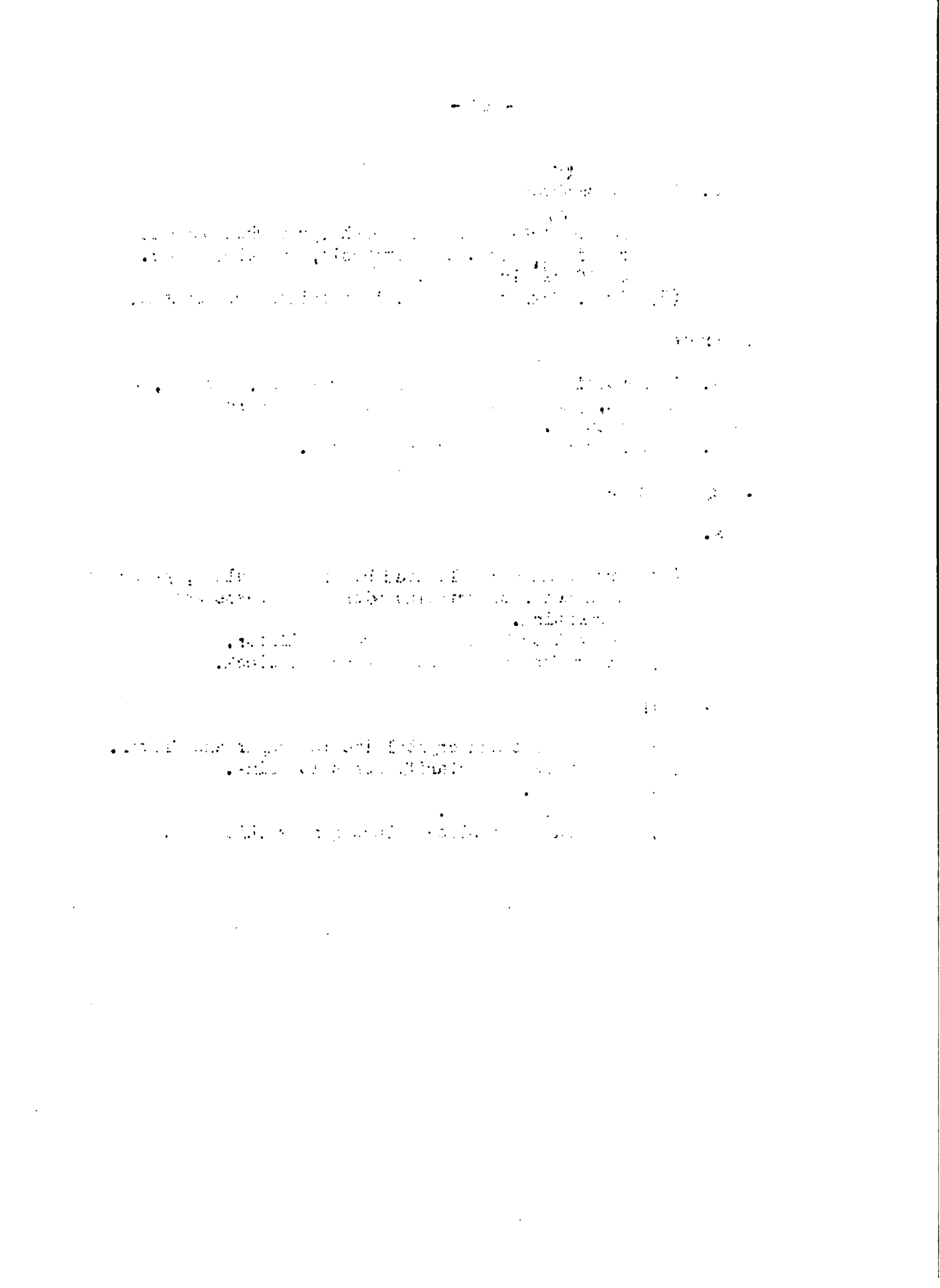
6. By-products

a. Pod walls

(1) Try to make cattle feed by grinding alone, grinding with pulp, or grinding with other waste and fermenting.
(2) Compost or burn to produce fertilizer.
(3) Fiber for wall board or concrete block.

b. Pulp

(1) Concentrate and crystallize for sugar and flavor.
(2) Pasteurize and clarify for soft drink.
(3) Make wine.
(4) Make jelly or jam.
(5) Make gum to replace quince gum as thickener.



SUMMARY OF CACAO DISEASE INVESTIGATIONS
October, 1947 to April 1, 1948

A. G. Newhall

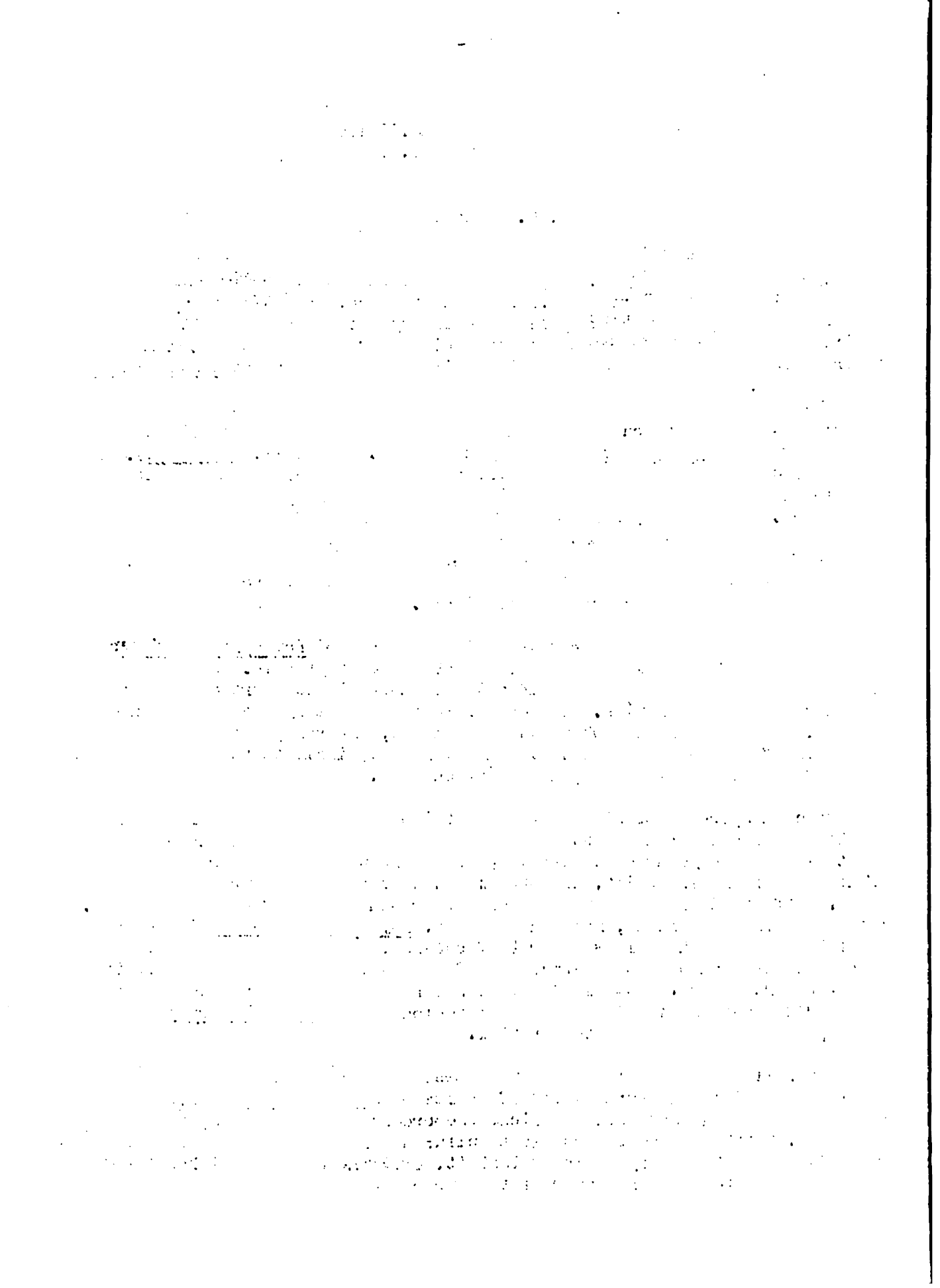
During the past six months progress has been made in cataloging the more important diseases of cacao occurring in Costa Rica, in determining the causal organisms, their life cycles, and the symptoms they produce. In addition the potency of a number of fungicides has been tested against their spores in the laboratory and to a limited extent against Phytophthora in seed beds.

The disease which causes more loss of marketable crop than all others combined is the Phytophthora pod rot caused by P. faberi (P. palmivora). It is estimated that 50 per cent of the pods were lost from the attacks of this fungus between September 1 and December 31 in many plantations in Costa Rica. Pods of any size were subject to attack and at any point from stem to tip. The causal fungus was isolated, not only from pods, but from the embryos of seeds within diseased pods, from the blackened tips of chupons suffering from wilt, from cankers found on twigs, and from the soil collected beneath thirty-five year old trees.

Pods inoculated with spores or living cultures of Phytophthora faberi were sometimes completely infected in eight or ten days time. Spores of the fungus were produced on pods in moist chambers in as short a time as five days after inoculation. Ten out of fourteen healthy pods became infected in five or ten days when placed on moist, naturally infested soil in the laboratory under conditions which certainly indicate that this fungus, like several of its relatives, does live on soil.

Using a spore suspension in water obtained by washing, scraping, or brushing sporangis from the surface of diseased pods infection was obtained by atomization on young cacao seedlings which resulted in the gradual death of leaves, of growing point, and the ultimate death of eight week old seedlings. Infection was also obtained on the growing tip of young hevea twigs. From the work of Reinking, Rorer and others, Phytophthora faberi is known to be the cause of a serious bud rot of coconut, and to be able to infect several other plants such as seedlings of annonas, manog, santol and fruits of tomato and papaya. This is one reason for not recommending the use of hevea or coconuts as shade for cacao in regions where Phytophthora pod rot occurs, which is in most of the Tropics.

The following fungicides have been tested on glass slides for their ability to inhibit the germination of spores of Phytophthora faberi, of Diplodia theobromae and Collectotricum theobromicolum. Since Phytophthora is the most important pathogen and since sulfur has long been known to be ineffectual and copper very toxic against it, only one organic sulphur compound was tested (Fermate). A number of the newer organic fungicides containing



either zinc or chlorine, and currently being tested in the United States, were tried. The copper compounds included Bordeaux mixture (4-4-50, 2-2-50, and 1-1-50); Tennessee Tribasic (53% Cu.) at 4,2, and 1 lb. per 100 gallons; Copper A compound (Cu. oxycloride, 45% Cu.) at 4, 2, 1 lb. per 100 gallons; Yellow Cuprocide (88% Cu.) at 2, 1, and 1/2 lb. per 100 gallons; Puratized III (4% Cu.) at 1 part in 150, 300, 800, and 1600.

The organic fungicides and their active ingredients included Dithane Z78 - Zinc ethylene bisdithiocarbonate (65%); Parzate - Zinc ethylene bisdithiocarbonate (70%); Fermate - Ferric-dimethyl-dithicarbonate (76%); Phygon - Dichloro-naphthoquinone (98%); Spergon - Tetrachloro parabenzoquinone (48%); Spergonex - Tetrachloro parabenzoquinone (____); Puratized - Phenyl mercuri-triethanol amonium lactate (5%).

These were employed at three strengths, the one commonly recommended, and two dilutions of one-half and one-fourth this strength. For Dithane Z78, Phygon, and Spergon we began with one pound to 100 gallons; with Parzate and Zerlate, 2 pounds and with Permate, 3 pounds. The spore germination tests indicated that the copper fungicides were much more effective than any of the others. In a special series of seven modifications of Puratized compounds, containing different quantities of copper and mercury, the copper was decidedly more effective than the mercury. Of the other copper fungicides, Bordeaux, even 2-2-50, was more effective than the others in these laboratory tests. In some tests Parzate showed up fairly well but Dithane and Phygon were not very effective.

In one non-replicated test of seven fungicides on 180 seedlings sprayed one day and inoculated the next with a spore suspension of Phytophthora, the best protectants included Parzate at 2 pounds; Tribazic, 4 pounds; and Yellow Cuprocide, 1-1/2 pounds, in 100 gallons. Bordeaux, 2-2-50, was less effective while, Dithane Z78 at 1 pound, Zerlate at 2 pounds and Puratized 111 (4% Cu.) at 1 to 300 were not much better than the average of the seven check plots. The Bordeaux was made up with a rather poor grade of lime procured locally.

In view of the difficulties surrounding the making of a first-class Bordeaux, of its poor keeping qualities, and of the need for a prepared fungicide ready for use, more work along fungicide testing lines is worth while, particularly with any new organics or compounds containing copper, such as Bouisol, Copper 8 quinolinolate, copper trichlorphenate, copper naphthenate, the glyoxaladines, Sinox and Elgetol.

Several ways of culturing the fungus to obtain fresh sporangia of Phytophthora for inoculation purposes were tried such as agar, peanut shells plus dextrose, potato plugs, and steamed cacao pods. None were as effective or satisfactory as cacao pods, ripe or green, washed and held in moist chambers for a week after inoculation. It was found essential to employ freshly formed sporangia, which develop near the margin of advancing lesions. Sporangia two or more days old germinate very poorly. They can be wiped or washed from a pod with a clean cloth and in twenty-four hours a fresh crop of viable sporangia may be secured. This may be done several times which makes one pod useful as a source of inoculum for a week.

By counting the number of sporangia found on an area approximately 4 sq. mm (935) and multiplying by the total area of the pod (480 sq. cm), it was calculated that an average sized pod can give rise to from five to ten million sporangia, each of which may contain from ten to twenty-five zoospores capable of initiating infection on pods, leaves, or chupons in a few hours in the presence of a thin film of moisture. Even if less than one hundredth of one per cent are able to find an infection court there still may be hundreds of infections initiated by one well placed diseased pod. It is obvious that removal of diseased pods once, twice, or even four times a month is inadequate to keep down such fast forming vast quantities of infectious inoculum. A good protective fungicidal barrier is probably cheaper and more effective in the long run.

Other Pod Rots Found in Costa Rica

Colletotricum and Diplodia pod rots are commonly found and a suspicion has recently been aroused that perhaps Monilia is present, although this lacks confirmation to date. Diplodia seems to occur only on mature pods and is of relatively little economic importance, although it has been isolated from twigs and probably is of considerable importance in connection with dieback and twig blight which is common in neglected plantations.

The best name for Diplodia pod rot is Dry Sooty Rot since in later stages the pod is covered with a deep layer of black soot-like spores. In early stages, which occur usually at one end of the pod, the brown discolored tissue is soon made rough, almost like coarse sand paper, by the eruption of multitudes of closely packed minute fruiting bodies of the fungus pushing their way up through the epidermis of the pod. The rot advances almost as rapidly as that caused by Phytophthora. The spores also germinate in a matter of a few hours and are produced in prodigious numbers. However, so far it has not been found to cause the great losses that Phytophthora does. Spores sprayed on seedlings in one test failed to cause any infections.

In the spore germination tests with fungicides mentioned earlier Diplodia theobromae appeared to be more easily inhibited by a greater variety of fungicides than Phytophthora. In addition to Bordeaux 2-2-50, Phygon, Zerlate, Yellow Cuprocide, and Fermate were rather effective, while Dithane, Spergon, and Puratized were not.

It seems likely that good cultural practices which include pruning and spraying for Phytophthora will probably eliminate this disease completely. It is said to be only a wound parasite.

Pink Rot or Anthracnose

The fungus causing the Anthracnose pod spot, Colletotricum theobromicolum, has been found attacking pods of all sizes. It causes a depressed or sunken circular dry rot which turns from light to dark brown. Later, on the surface of these spots, a layer of light yellowish to pinkish spores

breaks through the epidermis giving a bright dusty appearance over the dark brown background.

The fungus has been found in Costa Rica to be the cause of a great deal of spotting and dry marginal burning of cacao leaves. It has been repeatedly isolated from fruits, leaves, and twigs, and when spores are sprayed on seedlings the young leaves in two weeks' time break out with small dark brown circular spots, lesions on the veins, and marginal necrosis. From these lesions the same fungus has been reisolated. Older green leaves seem to be less susceptible, and much of the infection which results in ragged brown-margined, shot holed leaves is believed to have taken place when leaves were much smaller. Spores require a much longer time to germinate than those of Phytophthora or Diplodia (15 to 30 hours). Anthracnose on leaves seem to be worse on trees exposed to sunshine and in neglected plantations where it causes considerable loss of effective foliage but is nevertheless, even in these cases, not a very serious pod rot. Anthracnose can flourish under drier conditions than Phytophthora or Diplodia pod rots.

The name "anthracnose" has locally been employed for the spotting of pods of all ages caused by the stings of an insect believed now to be the result of feeding by Monolonium capsid bugs. In this ailment the spots are dark brown, remain uniformly about 2 millimeters in diameter, often have a scabby surface and at times a whitish center caused by the growth of a mold (Fusarium sp.). The fungus is superficial and the spots do not grow larger and are only about 2 or 3 mm deep. They are definitely of insect origin and should not be confused with the fungus pod spot. There are two other pod spots resembling that caused by Colletotricum, one of which is distinguishable by its slightly darker color and by the fungus fructifications which are black densely packed pycnidia developing in the centers of the sunken lesions. The other is superficial dry rot covered with white mold of the causal fungus (Fusarium sp.).

There is circumstantial evidence that the Colletotricum which causes leaf spot and anthracnose of seedlings may have its origin in the soil. It may even be the same fungus as the one commonly attacking coffee. When seeds are sown in sterilized soil or soil not previously used for coffee growing they have come up and remained for months quite free from leaf spot, but when grown in soil taken from between coffee trees they have suffered from much leaf spot from a very early age. This assumption needs further testing, however.

Anthrocnose will probably be controlled by the same two methods mentioned before of pruning and spraying and fertilizing as for Phytophthora. Spore germination tests on slides sprayed with fungicides have been too erratic to be dependable to date.

Another pod rot, found, but once recently at La Lola, seems to be caused by an undetermined, fast rotting dark gray green fungus which is not a Monilia species. It can attack young and old pods and needs further study. Pycnidia form under the dense green velvety mat of mycelium on

inoculated fruits in eight or ten days, and in pure culture. They are black and contain oval, sub-hyaline single celled spores similar in size and shape to immature Diplodia conidia. In the early stage of fructifications the appearance of the velvety mat of mycelium and the manner of spore formation might suggest Monilia for which a good technical description still seems to be lacking. Monilia pod rot was diagnosed only once as far as the writer knows and then from pods sent from Ecuador to California in 1917 where they arrived in a condition not the best for diagnostic purposes. In some respects the pod rot in question resembles the description given by Rorer in 1918 of so-called Monilia pod rot. If it should be the same disease its occurrence this far north is of some interest.

Seedling Disease Control

Cacao seedlings have been found to be subject to several stem rots apparently of soil origin. Brown lesions occur at or beneath the soil line sometimes deep enough to cause stunting and even death. From these lesions a Phyzoctonia, a Fusarium, and one other black pycnidial producing fungus have been isolated. Time has not yet permitted proving their pathogenecity but a test of several fungicides, including Dithane, Z78 Parzate, Zorlate, and Fermate applied to the upper 1 1/2 inches of soil by raking in at the rate of 1 gram per sq. foot just before sowing seed in an outdoor seed-bed indicated Fermate might give almost complete control.

Other diseases of minor importance encountered either at La Lola or the Institute include a root rot, perhaps caused by a species of Rosellinia, and the well known thread blight caused by Corticium (Pellicularia) Koleroga which grows over twigs and large leaves causing the latter to droop, drop off and hang by the string-like threads of the causal fungus.

Insect Pests of Cacao

While no work with the insects found on this crop has been done by the writer, during the past six months sufficient evidence of insect damage to pods and twigs has been observed to indicate that the principal pests include some species of Monalonium or capsid bug, one or two leaf hoppers, several ants, aphids, and thrips. While insects are not responsible for the cacao industry of this hemisphere being in the plight it is in, they no doubt do considerable damage and some of them constitute a threat as possible vectors of virus diseases, notably swollen shoot, and as probable disseminators of the spores of many of the fungus diseases this crop is subject to.

Immunization Studies by Crossing

Theobroma simiarum is native to Costa Rica and grows on the Institute grounds. Not much is known about its genetic constitution or the genes for resistance which it may harbor. Seedlings are being grown and four of them have been inoculated once with spores of Phytophthora faberi but no infection has been observed. Further inoculations with all the fungi occurring on cacao should be made. Without waiting for these results and to take

advantage of the specialized training and interest of Mr. Muñoz, he was encouraged to undertake the crossing of T. cacao with T. simiarum. Hundreds of hand pollinations were made and to date eight successful crosses of T. simiarum on T. cacao have been obtained. Two of these have since dropped off. None were successful when pollen of T. cacao was used on T. simiarum, although two or three self pollinations out of sixty that were made on the latter are holding on. It is believed that this is the first time this cross has ever been made and, while the parental stock used is not perhaps of a high order from the standpoint of quality and yield, it has demonstrated the feasibility of making such a cross. The cromosome number of both species has been found by Mr. Muñoz to be the same (20). Had pollen from clone 221, which is a heavy setter, been used, the results might have been more striking. Progenies from this cross should be critically studied as no one can foretell at present the value of the outcome. It may result in the introduction of some valuable genetic blood into the cacao germ plasm bank.

Recommendations

1. Multiply, develop, and disseminate as rapidly as possible strains or clones of cacao that inherently have high yielding capacity and good quality.

2. Work on pruning, grafting, budding, and training of trees to get the most out of them and to rehabilitate old plantations as quickly as possible.

3. Test and develop the best spraying and/or dusting practices for disease and insect control, including vapor treatments and spray concentrates.

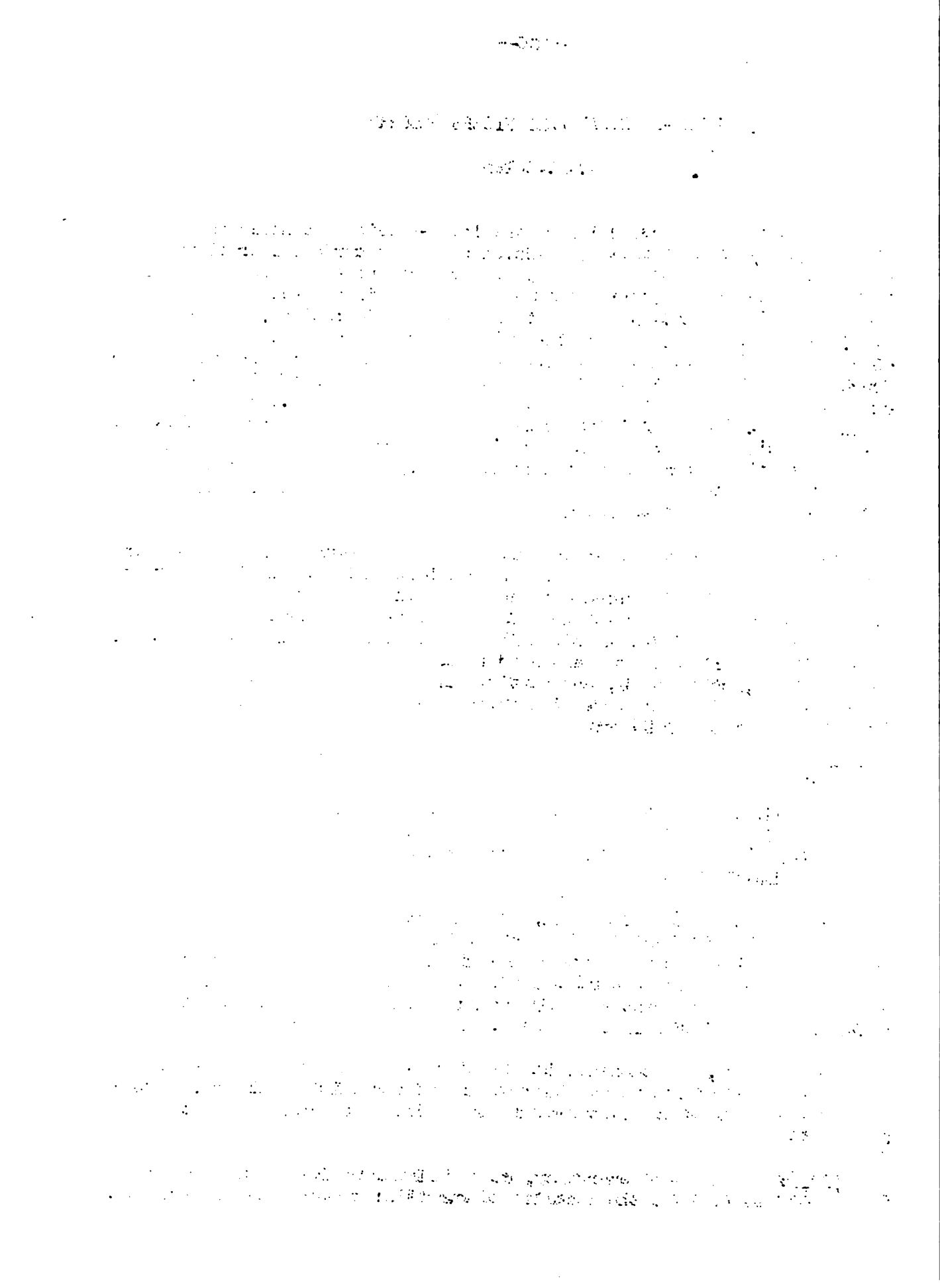
4. Test fertilizers and minor elements.

5. Evaluate carefully the need for shade at all stages of the newer, better clonal materials available.

6. Keep in touch with other centers of cacao research and exchange ideas.

7. Test all available Theobroma species for possible presence of genes resistant to some of the major diseases and insect pests.

8. Keep a close watch on the six pods resulting from Mr. Muñoz' crossing of T. simiarum on T. cacao. Grow the F^1 seedlings from them and distribute some of these to men who are interested in cacao research in their countries. Test these seedlings here against all available cacao diseases and insect pests and make future plans on basis of the results and on the availability of adequate long time supervision of genetic work on cacao at this Institute. Repeat this cross using pollen from the better clones now available.



INTER-AMERICAN PLANT FIBERS PROGRAM

J. L. Colom

The Committee on Production of the Inter-American Economic and Social Council at the Pan American Union has had under consideration during the past year the possibility of carrying out an action program to promote the production and improvement of certain vegetable fibers grown in Latin America. As a result of these considerations, the services of Dr. Brittain B. Robinson, of the Division of Cotton and Other Fiber Crops and Diseases of the United States Department of Agriculture, were secured by the Pan American Union during the latter half of 1947 to make a survey of the fiber plant industry in Latin America. In making his survey, Dr. Robinson visited some fifteen Latin American countries. Dr. Robinson's "Report on the Status of the Fiber Plant Industry in Latin America" which was completed in January, 1948 has been issued in Spanish and English and circulated widely in government departments and other institutions throughout the hemisphere.

This report has served as the basis for the preparation of an action program for the improvement of the soft and hard fiber producing industry in Latin America to be carried out through the Inter-American Economic and Social Council with the assistance of such inter-American specialized organizations as the Inter-American Institute of Agricultural Sciences. Various manufacturers of soft and hard fibers have expressed an interest in encouraging, cooperating, and participating in programs to sponsor the development of fiber production in this hemisphere. An outline of the proposed program follows:

Situation:

Plant fiber products are vital to the welfare of the American Republics. Their continual availability and their potential contribution to increasing the welfare of our producers and consumers involve problems of primary importance.

With the exception of cotton, the major supplies of the fibers used have come from extra-hemisphere sources. They have often been available from these sources under acceptable conditions of quality and price and have made a substantial contribution to world trade to the benefit of all concerned. It is apparent that fibers from traditional sources will continue to be a factor in the future.

Nevertheless, two elements in the situation make it imperative that we give major attention to the improvement of our existing fiber industries and their production and expansion to the point of optimum economic feasibility.

First: In times of emergency, caused either by international strife or economic disruption, the security of our fiber supplies is interrupted.

Second: Fibers, particularly those with tropical requirements of growth, have been produced in other parts of the world because of particular circumstances prevailing in the past rather than because of relative economic advantage. To the extent that we have in the Americas natural conditions of soil and climate equal to or superior to those of the traditional areas of production, we have the obligation to explore the possibility of developing fiber production supplementary to the present sources and to compete with them if our economies can be benefited.

Objectives:

1. To determine the conditions under which certain hard and soft fibers are now produced in the American States.

2. To explore the possibibilities for advantageous increases and improved or more profitable methods of fiber production.

3. To initiate a cooperative inter-American program of research, training, and promotion of improvements, emphasizing the application of technology to our fiber productions including:

   a. Selection of soils and regions
   b. Types of plants to grow
   c. Cultural requirements
   d. Methods of harvesting, cleaning, and packaging
   e. Certain basic investigations including

      (1) improvement of plants through selection and breeding
      (2) determination of chemical and physical characteristics of fibers in relation to variety, soils, climates, and methods of handling for correlation with their end uses

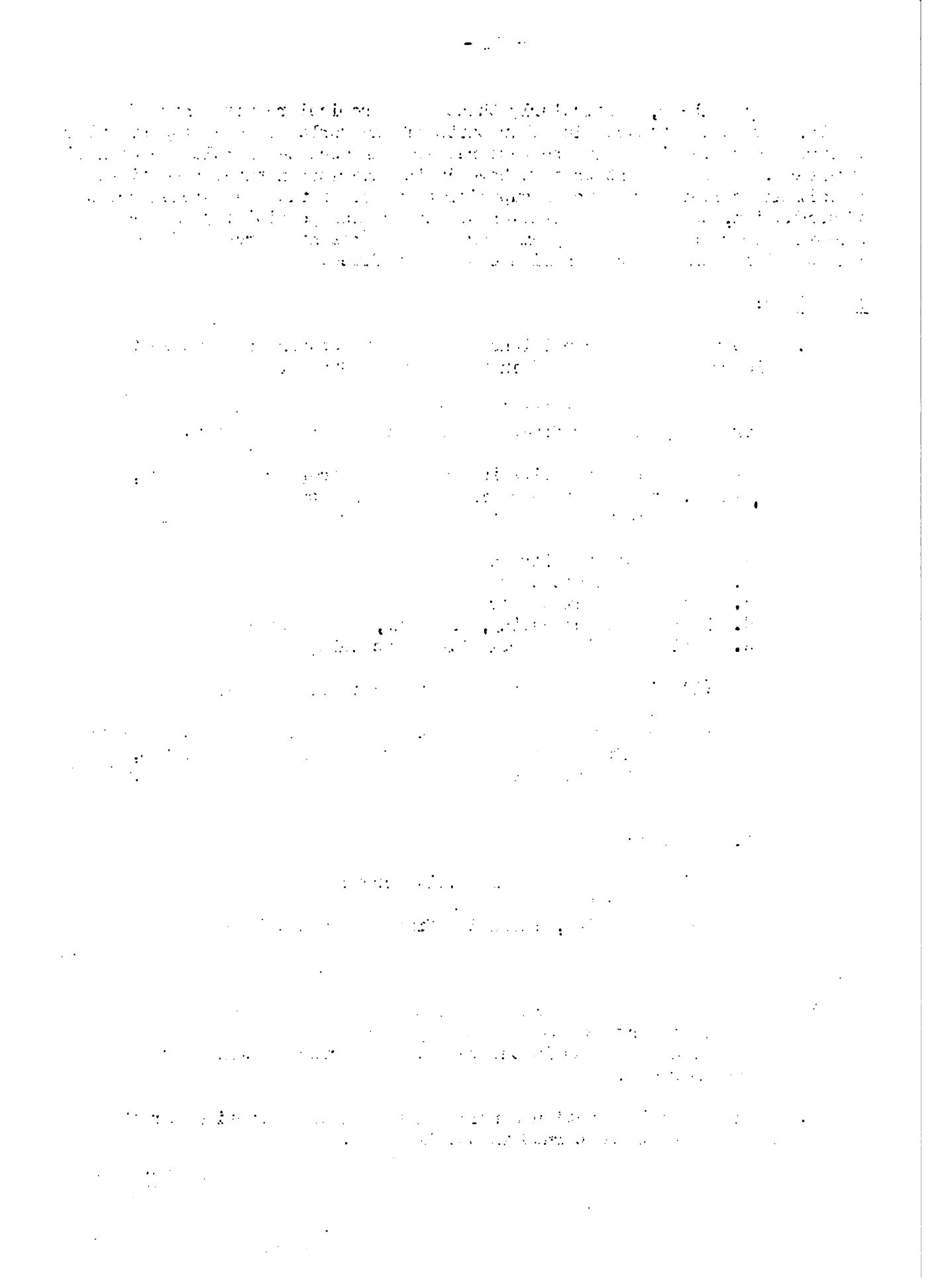
   f. Economic studies of

      (1) land use and competitive crops
      (2) production management
      (3) marketing, including financing and prices

Procedure:

1. Continue to survey world fiber supply and demand to analyze results of surveys made by others, with emphasis on domestic production and needs in the various countries as well as on export markets.

2. Maintain an information service on the fibers situation for the benefit of all concerned in the Americas.



3. Develop an Inter-American Fibers Center with the following functions:

   a. To carry out and promote basic research either at its headquarters or through cooperative arrangements and consultation with institutions or individuals in member countries.
   b. To assure that the results of all findings contribute to and strengthen the fibers industry through dissemination of results, calling of conferences of specialists, and an advisory service.
   c. To establish a reference collection of fiber plants or to assist in making collections more complete when they can be maintained elsewhere to a greater advantage.
   d. To train specialists at its headquarters or in combination with basic courses in universities.

PROGRESS REPORT

AGRICULTURAL ENGINEERING DEPARTMENT

Norton C. Ives

TILE DRAINAGE

PROJECT NO. 50 PROGRESS REPORT NO. 2

Date submitted: March 23, 1948

Leader : Norton C. Ives

Location: Institute

A 90° V-notch weir and concrete stilling tank were installed at the tile outlet of the drainage system in October and November, 1947. A series of test holes, 84 in all, were placed in lines at right angles to the tile lines. A topographic map with 1 foot interval contour lines shows the location of the tile lines, test holes, and the topography of the drainage field. The ground water levels, rainfall, and runoff data are plotted on a special blueprinted form which gives an excellent pictorial presentation of these data.

Two rather high intensity storms have occurred, which made possible an excellent set of cycle data. The ground water levels were read daily for short periods after each storm and periodically thereafter. They are plotted graphically on the blueprinted forms. Analysis of these ground water level curves for the 6-1/2 inch rain storm of January 14-15 shows that for the area between adjacent tile lines:

1. The soil did not reach the surface flooded stage;

2. Twenty-four hours after termination of storm ground water levels were approximately 85, 64, and 41 cms. below the surface for the 15.3 M, 28.0 M, and 45.7 M spacings, respectively.

Within a week to nine days the ground water table was down to the tile levels.

Assuming adequate drainage requirements for tropical rainfalls, soils, and crops to be:

1. prevention of surface flooding at any time;

2. draw-down of the high point of the water table midway between tile lines at rate of 25 cms. per day for first 60 cms. depth of soil and 6 cms. per day thereafter to a depth of 1 M,

the 150 ft. tile spacings would give adequate drainage in this soil for rain storms of intensities up to 5" in one day or 6" in two days, as indicated by the observations of this first storm.

The great amount of surface water ponding in other areas of this field after each storm shows the poor natural drainage characteristics of this field. It would appear that the soil at the far end of the field from the outlet where single tile lines only have been installed so far, has a more impervious soil. Mechanical laboratory analyses of these soils are to be made to determine this difference, if any. Also, a series of two or three laterals should be extended into this area to drain it and also to afford further study of its drainage characteristics.

Table I summarizes and compares the rate of water table draw-down at the midpoints between tile lines on three spacings of

15.3 M. or 50'

28.0 M. or 92'

45.7 M. or 150'

for the two high intensity rain storms that have occurred so far.

TABLE I. Ground Water Table Draw-Down After Two Storms

	TILE SPACING					
	50' 15.3M		92' 28M		150' 45.7M	
	Distances at midpoint between tile -- cm.					
	Below surface	Above tile	Below surface	Above tile	Below surface	Above tile
I. For rain of March 13 - 0.83" 14 - 3.00"						
Stake line A						
Max. Height at 0h	-28	82	-13	84	-13	86
+20h(raining)	-57	54	-16	81	-17	83
Drawdown + 44h	30	22	22	59	23	59
" + 68h	16	6	19	40	17	41
Stake Line B						
Height at + 44h	-79	31	-71	56	-46	66
Drawdown + 68h	12	19	20	36	15	50
I. For rain of Jan. 14 - 5.71" 15 - 0.82"						
Stake Line A						
Max. Ht. at 0h	-40	71	-2	94	-6	93
Height + 24h (.82" rain)	-83	28	-19	79	-12	86
Drawdown +48h	14	14	31	47	29	58
" + 72h	9	3	25	22	20	38
" + 96h	2	1	12	11	7	31
" + 120h	1	0.	6	4	4	22
Stake line B						
Max. Ht. 0h	-19	90	-21	105	-2	109
Height +24h(rain)	-57	52	-46	80	-12	99
Drawdown + 48h	21	31	32	47	30	69
" + 72h	11	20	22	25	18	51
" + 96h	4	16	9	15	5	46
" + 120h	3	12	5	10	10	35

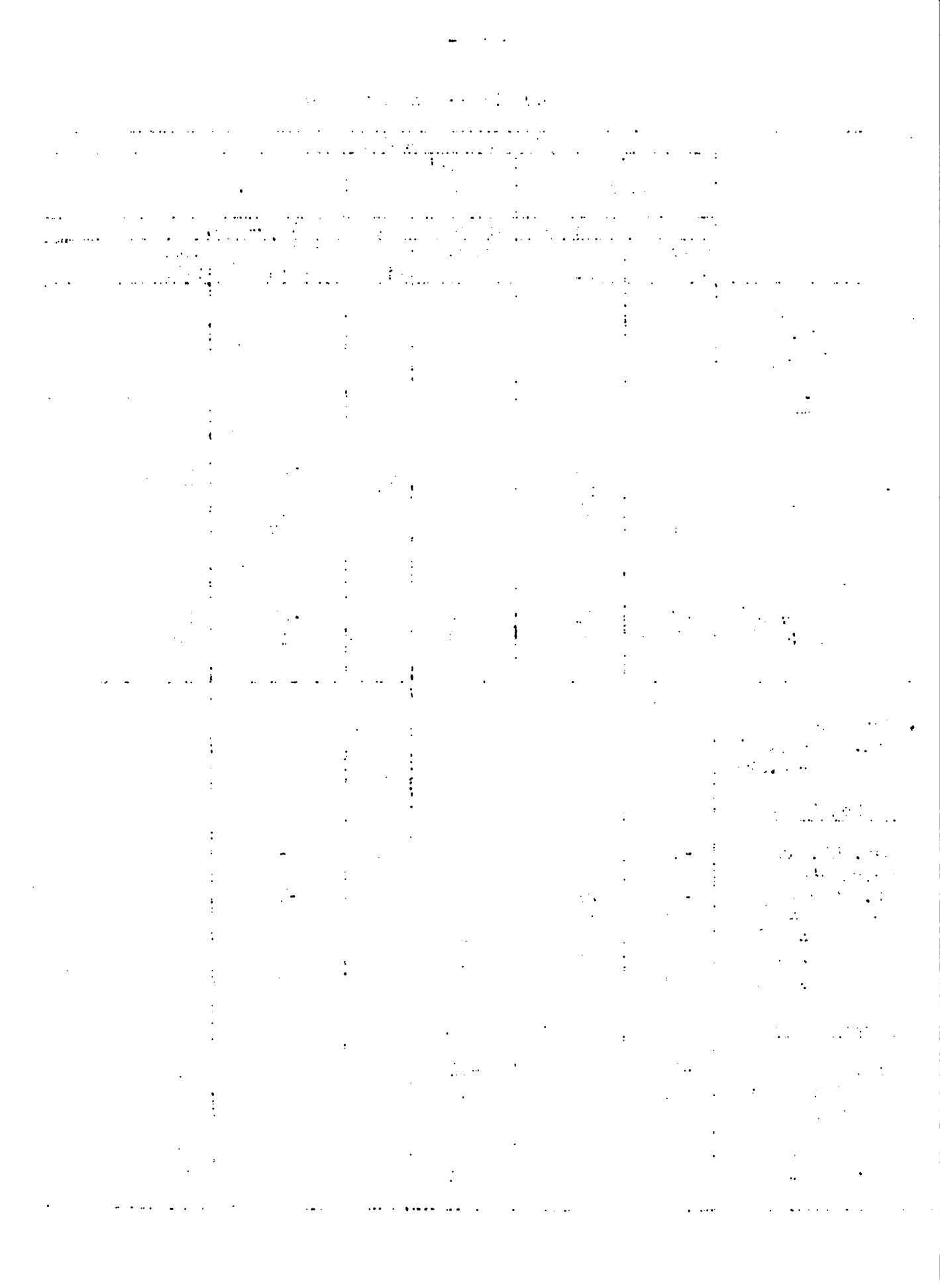
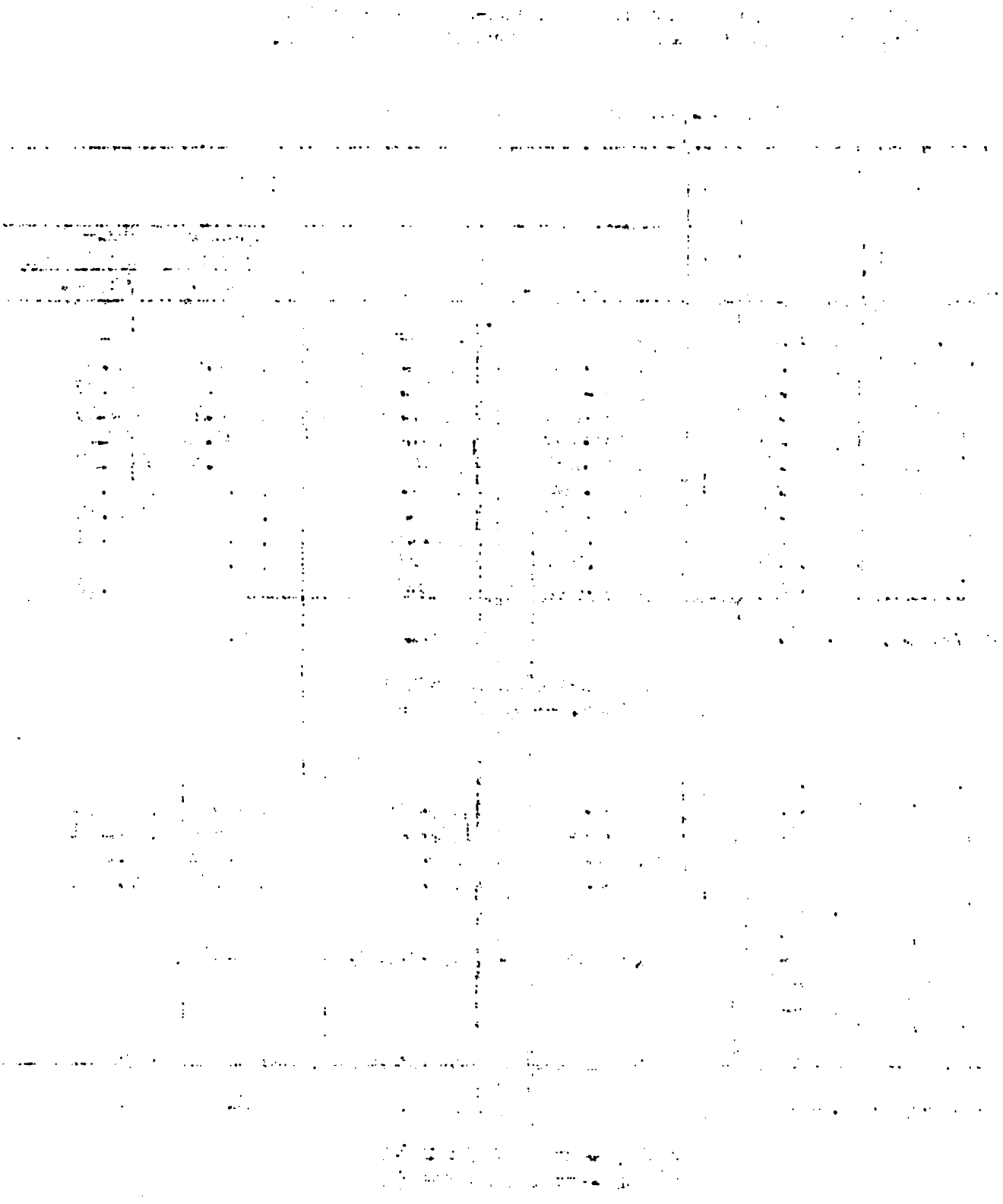


Table II below summarizes the run-off data obtained by use of a 90° V-notch weir manually read not more than once a day.

TABLE II. Drainage System Runoff Data

Date	Rainfall	RUNOFF			
		C.F.S.	Acre Inches	Inches/24 hrs.- Drainage Coefficient 10 A.	15 A.
Jan. 14	0.00	trickle	-	-	-
" 15	5.71	0.682	16.20	1.62	1.08
" 16	0.82	0.550	13.10	1.31	0.87
" 17	0.03	0.312	7.42	0.74	0.49
" 18	0.00	0.169	4.02	0.40	0.26
" 19	0.15	0.136	3.24	0.32	0.21
" 20	0.00	0.104	2.47	0.25	0.17
" 21	0.01	0.079	1.88	0.19	0.13
" 22	0.04	0.07	1.66	0.16	0.11
" 23	0.04	0.063	1.50	0.15	0.10
" 24	0.00	0.043	1.03	0.10	0.06
Total . . .	6.80		52.54	5.25	3.50
		For 10 A. -- % drainoff = 77%			
		For 15 A. -- % drainoff = 52%			
Mar. 12	0.15				
" 13	0.83	0.216	5.15	0.51	0.34
" 14	3.00	0.199	4.74	0.47	0.31
" 15	0.00	0.167	3.98	0.40	0.27
" 16	0.00	0.139	3.30	0.33	0.22
" 17	0.00)				
" 18	0.20)				
" 19	0.00)-----	0.107 av.	15.30 av.	0.255 av.	0.17 av.
" 20	0.04				
" 21	0.00				
" 22	0.00				
" 23	0.00	0.034	0.81	0.08	0.05
Total . . .	4.22		33.28	3.33	2.22
		For 10 A. -- % drainoff = 79%			
		For 15 A. -- % drainoff = 53%			



Most significant are the drainage coefficient values obtained from this runoff data. Drainage coefficient is defined as inches of rainfall drained off per twenty-four hours.

For the first storm the maximum rate of runoff measured ten hours after the peak of the storm was 1.62", assuming 10 acres as the area effectively drained at that time. Inspection of the ground water profiles substantiates this as a reasonable assumption especially with the ground water at the high level stage. For the first storm (6-1/2" rain) the ground water levels were not recorded immediately before the storm but an observed small discharge at the tile outlet indicated the ground water table of the field to be near the tile level.

Observations immediately following the storm indicated very little surface runoff from the drained area of this field. Thus, the 5.7." rain, most of which fell the night of January 14, was almost entirely absorbed by the first meter depth of the soil profile. The 3.83" rain recorded for March 13, most of which fell in the early morning and afternoon of the 12th, brought the water table approximately three-fourths as close to the surface as did the previous storm of 5.71". Before the first storm the ground had a light crop of weeds while for the second storm it had been cultivated for two weeks preparatory to planting and in addition a quarter-inch rain occurred on March 5.

Thus it can reasonably be assumed that the soil was at field capacity or nearly so before each rain. These data, therefore, show that the free water capacity of the first meter depth of the soil is in the region of 6". In other words, if this soil were completely saturated, an equivalent of approximately 6" of water, would have to be removed from the first meter depth to obtain thorough drainage.

Another approach which indicates the approximate accuracy of this result is the amount of drainoff necessary to lower the water table to tile level after the soil was saturated nearly to the surface level during the first storm. Fortunately there was no rain following either storm for a week or more and, as the tile discharge was practically zero for the first storm, and the ground water levels were measured to be at tile levels just before the second storm, the drainoff consisted only of water that fell during the storm.

As shown in Table II the total measured drainoff necessary to bring ground water back to tile level after the first storm was 77% of the rainfall that fell on ten acres or 52% for fifteen acres. For the second storm it was 79% of the rainfall on ten acres or 53% if the area assumed to be drained was fifteen acres.

Water is also removed from the soil by deep percolation, transpiration of plants, and evaporation. The water profile levels for the undrained area show that water lost by these methods in a week to ten days time, (see the C line profiles for the first storm) approximates one-fifth of that removed by drainage, as the drawdown for the undrained area was about one-fifth of the drained area during the first week to nine days.

It should be recognized that much of the above analysis is based on certain assumptions, but many of these assumed factors can be quite accurately determined by change and improvement in the experimental technique. The above analysis is presented primarily to show simple and direct field methods of approach for an experimental determination and study of the drainage properties and characteristics of a given soil, which methods require little technical knowledge and equipment.

For this project, however, additional equipment and technical study and analysis are planned, such as:

1. Installation of automatic water level recorder for continuous record of runoff measurements in the tile outlet;

2. Automatic recording rain gage installed near field site;

3. Border cut-off tile lines to accurately define or limit the area drained.

4. Detailed mechanical and chemical analysis of the soils for the various sections of the field to determine their correlation to drainability, if any, and to compare with other such data available for soils in the temperate regions, such as the United States.

5. Direct permeability measurement studies of small, confined areas within this drainage system and other areas needing drainage.

SOME PHYSICAL CHARACTERISTICS OF SOME COMMERCIAL LUMBERS OF COSTA RICA

PROJECT NO. 57 PROGRESS REPORT NO. 1

Date submitted: March 12, 1948

Leader : Norton C. Ives

Assistant: Gregorio Alfaro

Location : Institute

The following phases of the lumber study have been treated to date:

A. Moisture content of lumber

Table No. I shows moisture contents of all woods as received from the lumber mill. Moisture per cent is expressed on the dry basis and was determined by the oven-drying method.

B. Rates of lumber drying

The common practice of seasoning lumber in this region is that of placing the boards standing on end in the sun for a period of two or three weeks before using. For some woods this method appears to be quite satisfactory. However, for others warpage and checking are quite severe. Kiln drying has not yet been introduced or adapted in general in the industry. Most lumber is generally sold as it leaves the sawmill, the only seasoning being that provided on the construction job prior to its use.

Drying rates were determined in conjunction with the other tests. The observations are recorded in Tables I & V. Any effect due to the probability of case-hardening on the oven dried lot was not studied. The figures are indicative and comparative in nature only.

The relative drying rates given in Table I for the various kinds of lumber are quite fictitious. They show relative time necessary for oven dried samples to go from 20 to 10 per cent moisture. When exposed to the sun some of the wood samples dried to 17 per cent, the moisture equilibrium content for the lumber at 80 per cent relative humidity, within a relatively short period of time, while others such as Manu and Pochote were extremely slow in seasoning. After four mohths of exposure in the sun their moisture contents are still above 40 per cent. The group exposed to the sun were also exposed to all other elements of the weather. However, the rainfall during this exposure period was subnormal for this region. There was slight rainfall on afternoons and evenings of about half the days. Less than 10 per cent of days had

completely overcast skies. The effect of the sun on the rate of drying will be noted by comparison of the figures in Graphs 2 and 3. However, several of the samples exposed to the sun were quite severely checked upon reaching the lower moisture contents. Further study is necessary to determine possibilities and limitations of natural drying practices.

C. Permatox absorption

Small clear specimens, 1-1/2" x 1-1/2" x 6", oven-dried to 24 per cent or less moisture, were submerged in 10-l kerosene-Permatox solution. This is a 5 per cent Pentachlorylphenyl preservative suitable and recommended for the cold soak method of treatment of lumber. While the cost of material for this method of treatment is slightly more expensive than the cresote method, yet the ease or simplicity of treatment in that no special equipment is required, makes it easily adaptable for almost any area.

The absorption in pounds per cubic foot of lumber are reported in Table I. Recommended absorption varies from 4 to 7 pounds per cubic foot, according to subsequent exposure. However, maximum absorptions for soaking periods up to 72 hours were below these recommendations for all of the woods treated. The flame test and chemical dye test were both tried to check amount of penetration, with very poor results. Further study is necessary for two or three of the most common lumbers to determine the possibilities and limitations of this treatment.

D. Durability studies installed

The 3/4" x 8" x 11' boards used for erosion control plot partitions are comprised of all woods listed in Table I, except Nos. 11, 14, and 17.

All boards were treated in a soaking tank with Permatox solution, except one board of each specie which was left for check. Volume absorptions of the solution of each batch of 45 boards were recorded. However, the weighing of individual boards both before and after treatment was later introduced along with the tank solution level readings before and after treatment. There was considerable variation between individual boards in amount of absorption, and in general, the total amount of absorption was considerably less than the 4 to 7 pounds recommended. All boards were seasoned under a roof to 24% or less moisture.

The durability of the lumber so treated will be observed by periodic inspection.

E. Specific gravity determinations

Specific gravity determinations were made both for the green and oven-dried specimens. Only the determinations for the oven-dried

TABLE I. LUMBER STUDY DATA - PROGRESS CHART

No.	Lumber kind common name *	% moisture in lumber as received	Specific gravity: Value D.B.	Specific gravity: % max. variation of specimens fm.av.val.	#/c.f./Permatox absorp.[1]: 1.5x1.5x6" specimen 24 hr. immersion	#/c.f./Permatox absorp.[1]: Boards in tank 48 hr. immersion	Modulus of Rupture in Compression or Crushing Strength: % moisture dried in oven	Modulus of Rupture in Compression or Crushing Strength: #/sq.in.	Modulus of Rupture in Compression or Crushing Strength: % moisture sun dried	Modulus of Rupture in Compression or Crushing Strength: #/sq.in.	Modulus of Rupture in Compression or Crushing Strength: % moisture dried under roof	Modulus of Rupture in Compression or Crushing Strength: #/ sq. in.	By F.P.L. formula 6,730 G G (dry basis)	Av. No. of % Tagg-Hep. Moisture Meter read too high or too low	Relative drying rate
1	Guanacaste	48-118	.43	5	2.32	-	26.0	2760	21.8	2340	18.1	2000	2900	+ 5	40
2	Cedro At.	35-58	.47	30	-	-	-	-	-	-	-	-	-	-1 to + 8	-
3	Pochote	73-104	.45	4	1.16	1.1	34.0	2500	N.T.	-	41.0	1870	3030	+ 6	60
4	Cristobal	17-37	.74	2	3.10	-	16.5	6140	14.3	5900	16.0	5460	4980	+ 1	-
5	Roble Neg.	32-62	.86	16	0.65	1.74	-	-	11.5	4450	15.4	-	-	+ 1	55
6	Laurel	61-186	.46	36	1.30	-	14.5	3440	16.7	3560	18.0	3100	3100	+ 1	35
7	Cedro Pac.	43-65	.37	7	-	-	-	-	-	-	-	-	-	0	-
8	Cenizero	22-56	.57	14	2.28	-	22.0	3000	20.5	3110	19.6	3020	3840	+ 7	35
9	Sura	36-91	.67	16	2.65	-	36.0	5420	20.0	2670	20.4	4580	4500	+ 3	60
10	Ced. Macho	33-49	.50	6	1.35	2.18	23.0	4670	18.3	4220	20.4	4220	3360	-	35
11	Caoba	23	.53	0.5	1.21	-	20.5	4300	16.2	3900	17.1	3560	3560	-	30
12	Gavilan	20-98	.59	8	2.54	1.08	21.0	4260	19.4	4000	18.5	4800	3970	+ 2	-
13	Almendro	44-70	.64	11	4.30	1.23	26.0	5000	20.5	4450	18.0	4580	4300	+ 3	35
14	Manu	101-108	.56	2	1.66	-	26.0	3780	N.T.	-	54.5	4080	3770	-	100
15	Espavel	71-100	.50	8	5.80	2.17	21.0	1950	23.2	1780	18.1	2000	3360	+ 3	40
16	Compano	30-95	.71	21	3.66	3.48	20.0	5550	19.8	5000	20.8	4530	4780	-	30
17	Guapinol	17	1.05	1	0.70	-	16.0	5900	15.3	7550	16.3	6660	7050	-	-

TABLE I. LUMBER STUDY DATA - PROGRESS CHART

No.	Lumber kind common name *	% moisture in lumber as received	Specific gravity: Value D.B.	Specific gravity: % max. variation of specimens fm.av.val.	#/c.f./Permatox absorp.[1]: 1.5x1.5x6" specimen 24 hr. immersion	#/c.f./Permatox absorp.[1]: Boards in tank 48 hr. immersion	Modulus of Rupture in Compression or Crushing Strength: % moisture dried in oven	Modulus of Rupture in Compression or Crushing Strength: #/sq.in.	Modulus of Rupture in Compression or Crushing Strength: % moisture sun dried	Modulus of Rupture in Compression or Crushing Strength: #/sq.in.	Modulus of Rupture in Compression or Crushing Strength: % moisture dried under roof	Modulus of Rupture in Compression or Crushing Strength: #/ sq. in.	By F.P.L. formula 6,730 G G (dry basis)	Av. No. of % Tagg-Hep. Moisture Meter read too high or too low	Relative drying rate
1	Guanacaste	48-118	.43	5	2.32	-	26.0	2760	21.8	2340	18.1	2000	2900	+ 5	40
2	Cedro At.	35-58	.47	30	-	-	-	-	-	-	-	-	-	-1 to + 8	-
3	Pochote	73-104	.45	4	1.16	1.1	34.0	2500	N.T.	-	41.0	1870	3030	+ 6	60
4	Cristobal	17-37	.74	2	3.10	-	16.5	6140	14.3	5900	16.0	5460	4980	+ 1	-
5	Roble Neg.	32-62	.86	16	0.65	1.74	-	-	11.5	4450	15.4	-	-	+ 1	55
6	Laurel	61-186	.46	36	1.30	-	14.5	3440	16.7	3560	18.0	3100	3100	+ 1	35
7	Cedro Pac.	43-65	.37	7	-	-	-	-	-	-	-	-	-	0	-
8	Cenizero	22-56	.57	14	2.28	-	22.0	3000	20.5	3110	19.6	3020	3840	+ 7	35
9	Sura	36-91	.67	16	2.65	-	36.0	5420	20.0	2670	20.4	4580	4500	+ 3	60
10	Ced. Macho	33-49	.50	6	1.35	2.18	23.0	4670	18.3	4220	20.4	4220	3360	-	35
11	Caoba	23	.53	0.5	1.21	-	20.5	4300	16.2	3900	17.1	3560	3560	-	30
12	Gavilan	20-98	.59	8	2.54	1.08	21.0	4260	19.4	4000	18.5	4800	3970	+ 2	-
13	Almendro	44-70	.64	11	4.30	1.23	26.0	5000	20.5	4450	18.0	4580	4300	+ 3	35
14	Manu	101-108	.56	2	1.66	-	26.0	3780	N.T.	-	54.5	4080	3770	-	100
15	Espavel	71-100	.50	8	5.80	2.17	21.0	1950	23.2	1780	18.1	2000	3360	+ 3	40
16	Compano	30-95	.71	21	3.66	3.48	20.0	5550	19.8	5000	20.8	4530	4780	-	30
17	Guapinol	17	1.05	1	0.70	-	16.0	5900	15.3	7550	16.3	6660	7050	-	-

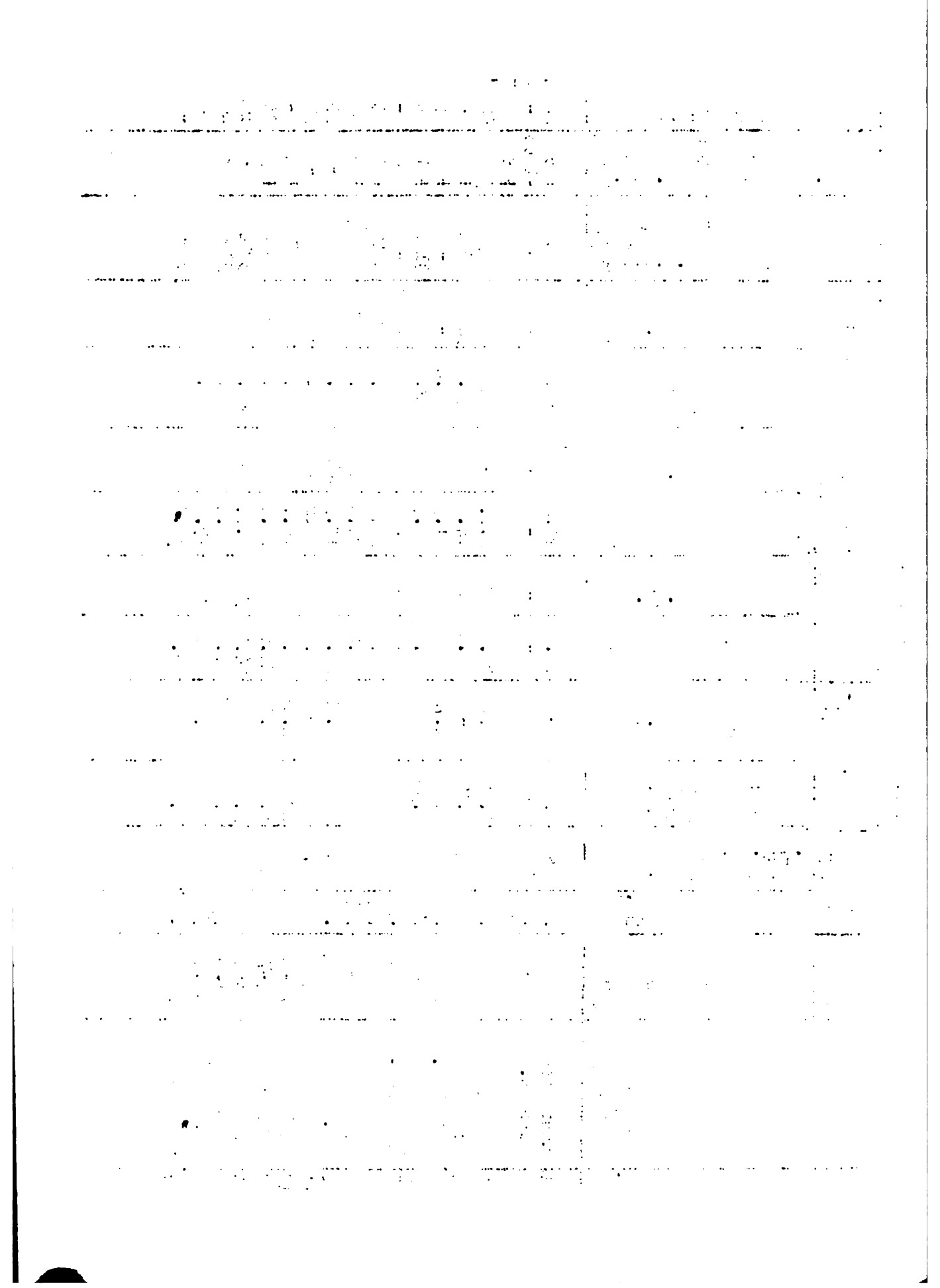


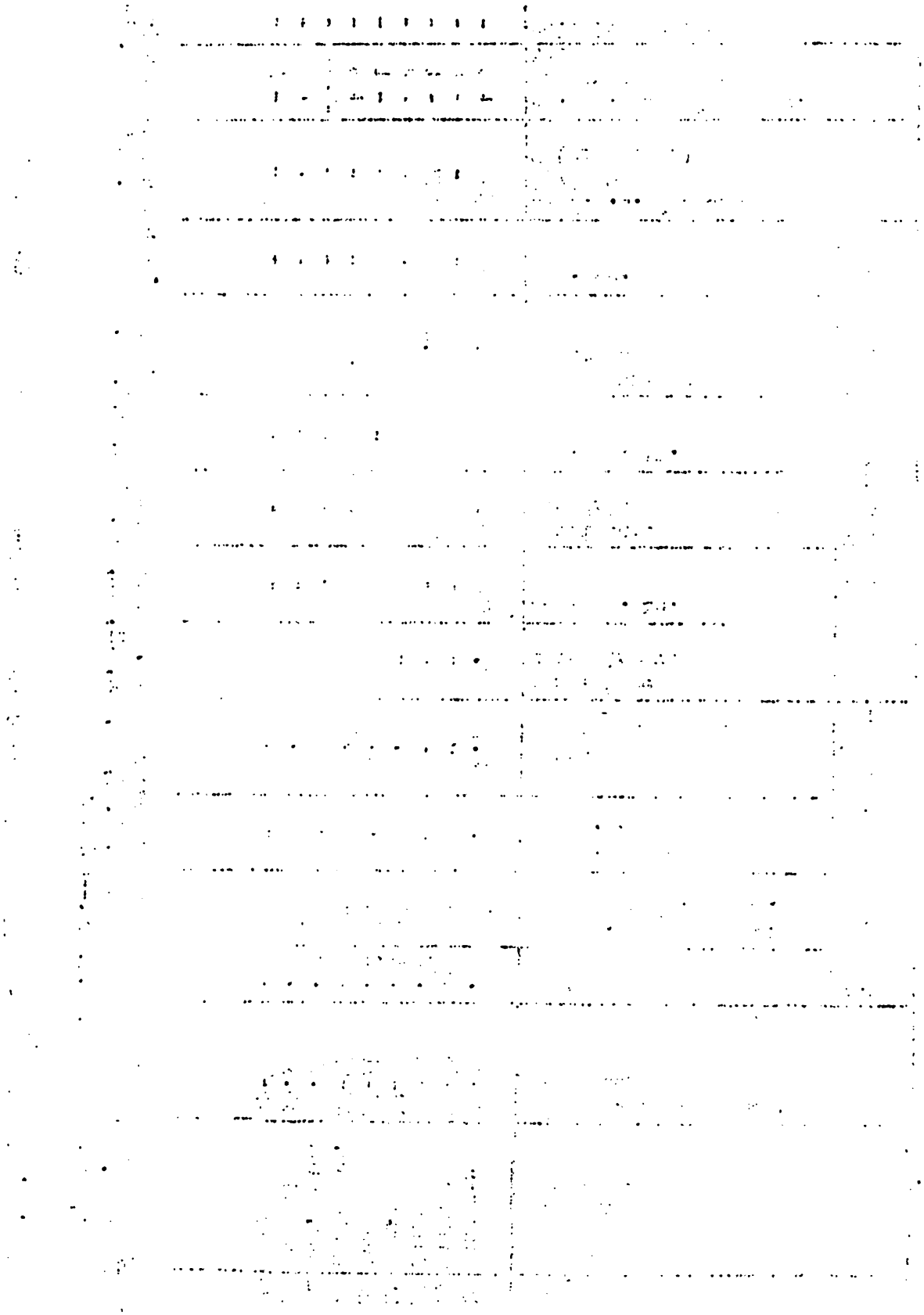
TABLE I. LUMBER STUDY DATA - PROGRESS CHART (cont'd)

No.	Lumber kind common name *	% moisture in lumber as received	Specific gravity		Lbs/c.f. Permatox absorp. 1/		Modulus of Rupture in Compression or Crushing Strength						By F.P.L. formula 6,730 G / G (dry basis)	Av. No. of % Tagg-Hep. Moisture Meter read too high or too low	Relative drying rate
			Value D.B.	% max. variation of specimens fm.av.val.	1.5x1.5x6" specimen 24 hr. immersion	Boards in tank 48 hr. immersion	% moisture dried in oven	Lbs./sq. in.	% moisture sun dried	Lbs./sq. in.	% moisture dried under roof	Lbs./sq. in.			
18	Guayacan	20-28	.83	16	5.21	2.7	19.0	5500	18.1	5800	18.6	5340	5580	+ 6	-
19	Guatuzo	42-56	.72	3	-	-	-	-	-	-	-	-	-	- 1	-
20	Quina	22-34	.68	6	-	-	-	-	14.0	4450	16.0	5110	4570	- 1	-
21	Maria	18-60	.55	20	-	3.3	-	-	-	-	-	-	-	- 2	-
22	Ira	18-71	.48	12	-	5.4	-	-	-	-	-	-	-	- 1	-
23	Roble Sab.	42-55	.47	4	-	4.8	-	-	-	-	-	-	-	+ 3	-
24	Ced. Dulce	18.38	.39	9	-	-	-	-	-	-	-	-	-	-3-½	-
25	Magnolia	35.93	.59	11	-	5.65	-	-	-	-	-	-	-	+ 4	-
26	Quizarra	45-87	.50	6	-	3.26	-	-	-	-	-	-	-	- 1	-

1/ Lumber was dried down to 24% or less moisture. Average absorption figures for batch treatment in tank. Kind Nos. 1, 2, 3, 4, 7, 8, 9, 10, 20, 21, 22, --2.6 Lbs./c.f. Av.--1st batch. Kind Nos. 19 6, 24 - 3.23 Lbs./c.f. Av.--6th batch

N. T. - not tested

* For scientific names see special Forest Products Laboratory report "Lumbers of Cost Rica"



pieces are reported in Table I, as the moisture contents of the specimens when green were extremely variable among the different samples of the same kinds of woods, and the amount of previous seasoning was not known. As characteristic of many of the tropical woods, the variation of specific gravity among boards taken from the same log is considerable, as noted by the maximum per cent variation recorded in the adjacent column in Table I.

F. Modulus of rupture in compression or crushing strength.

Modulus of rupture or crushing strength was determined on 1-1/2" x 1-1/2" x 6" specimens by using a hydraulic press and gage. Single specimen test results are given in Table I along with the moisture content at the time of the test.

The crushing strength as computed by the formula developed by the Forest Products Laboratory for green wood--6730 G, is shown in the table by way of comparison. However, no attempt was made to correlate these two results by adjusting for the moisture content, as these test results were for single specimens only.

G. Check of Tagg-Heppenstall moisture meter.

This moisture meter, received in late February, was used on all previously oven-dried specimens to check accuracy of moisture reading according to species of lumber. The variation of the meter readings are given in Table I. As will be seen, the meter readings in general were high for the low density woods, although this tendency was not consistent. Further tests will be made to compare readings made before lumber is oven-dried.

H. Preliminary gluing tests.

Some preliminary glue tests were made on some small shear block specimens. To study some of the gluing requirements and characteristics as affected by:

a. Permatox treatment

b. Gluing characteristics of the new resorcinol glues for these woods and climate conditions.

c. Method and pressure

   (1) Nailing
   (2) 20 pounds per square inch
   (3) 100 pounds per square inch

d. Kind of wood

e. High moisture contents at time of gluing

Resorcinol glues obtained for the study so far are:

(1) Cascophen RS 216
(2) Penacolite G 1131
(3) Penacolite G 1215
(4) Durez 13795

An approximate method of testing was used. Specimens consisted of two 3/4" x 3" x 6" blocks and two 1-1/2" x 3" x 6" blocks with the 3" x 6" faces glued. The number of specimens used were insufficient and the test conditions were not controlled sufficiently to make possible any accurate comparisons of the various factors. Such detailed studies have been made by the Forest Products Laboratory for temperate zone lumbers as reported in Bulletin 1500 entitled "Gluing of Wood." However, the tests did show some limits and possibilities for these lumbers and the high moisture conditions of this region.

Many of the test specimens buckled before failure which indicated the desirability of using a jig such as developed by Forest Products Laboratory. The relatively low strength values at failure of the glue joint and high percentage of glue joint failure in certain cases are not explainable from these data but may be attributed to high moisture content of 24 per cent and above and the use of the maximum amount of glue-fil in the glue for these tests.

Further tests with greater control are planned to investigate these factors. Some of the preliminary test results are tabulated below:

Table II

Effect of Permatox Treatment on Gluing Characteristics
Pressure 100#/sq. in.
Only one specimen each

Kind of Wood	Treated or Untreated	Per cent Moisture	Per cent Wood Moisture	Lbs/sq.in. at failure
Laurel	Treated	16	95	800
Laurel	Untreated	18	30	1000
Ira	Treated	20	60	600
Ira	Untreated	24	90	250
Cedro M.	Treated	15	100	1166
Cedro M.	Untreated	17	90	666

From the above table it appears that Permatox treatment has little effect on the strength of glue joints. The wood surfaces were planed slightly by a shallow cut pass over a jointer in preparation for gluing.

TABLE III

Use of Glue with Nails
One 6d. nail per 4 square inches. Two 3/4" boards nailed and glued parallel to grain. Nails unclinched. Results of one specimen.

Kind of Wood	Per cent Moisture	Per cent Wood Moisture	Lbs/sq.in. at failure
Cedro M	17	85	440
Laurel	20	90	450
Guayacan	24	5	625
Compano	24	25	500

Fastening two 3/4" boards with 6d. nails would develop about the lowest possible nailing pressure in practical usage. For low density woods the resultant joint was stronger than the wood at moisture contents 17 - 24 per cent. This shows the excellent possibilities of strengthening and stiffening joints by the use of glue before nailing.

TABLE IV

Kind of Lumber
One specimen each

Kind of Wood	20lb/sq.in. Per cent Moisture	20lb/sq.in. Per cent Wood Moisture	20lb/sq.in. Lbs/sq.in.	100 lb/sq.in. Per cent Wood Failure	100 lb/sq.in. Lbs/sq.in.
Quina	+ 24	20	485	40	760
Laurel	18	98	670	97	860
Compano	24	No failure at	1140	90	950
Cedro M.	20	90	500	97	760
Ira	18	95	460	100	380
Guapinol	+ 24	2	950	2	950

When moisture content was 24 per cent or below the per cent of wood failure was quite satisfactory. Even at glue joint pressure of only 20 pounds per square inch, the above tests are at best indicators only. The control and replication of the tests must be greatly increased before results will be considered applicable to wide range conditions.

I. Seasoned lumber moisture contents for tropical conditions

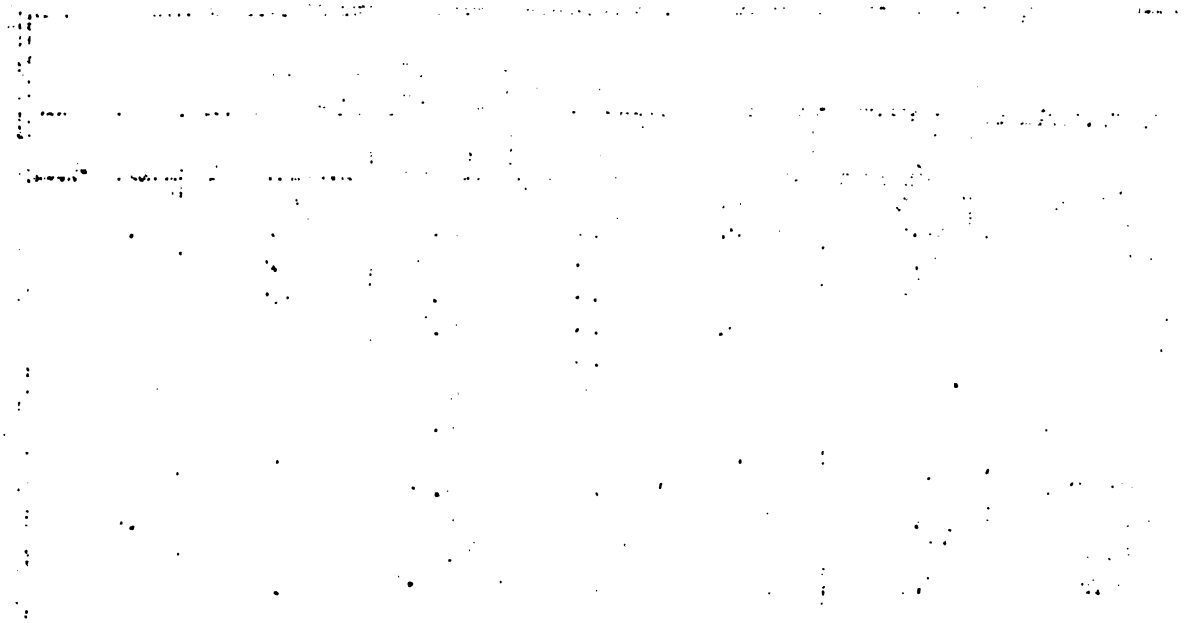
All oven-dried wood specimens have been stored in the laboratory and thus are exposed to air at 80 per cent average relative humidity. The equilibrium moisture content, or seasoned moisture content, will be checked for the various lumbers as well as the time necessary to reach equilibrium content from zero per cent. On March 5, the moisture contents of specimens dried November 15 had reached 10 to 15 per cent.

TABLE V. OBSERVED DRYING RATES OF SOME TROPICAL LUMBERS*

	Dried in air oven with forced air circulation -- 100° C					
	As Received	3 hr.	8 hr.	15 hr.	25 hr.	65 hr.
1 Guanacaste	42.0	24.4	12.9	6.9	2.8	0
3 Pochote	126.0	108.	76.0	56.6	32.4	0.2
4 Christobal	17.0	7.3	3.3	1.8	0.8	0
5 Roble Negro	67.6	52.1	39.2	29.2	15.8	0
6 Laurel	43.9	25.8	14.0	8.1	2.9	0
8 Cenizaro	130.0	85.8	47.4	24.4	6.0	0
9 Sura	57.0	38.6	24.7	16.4	7.8	0
10 Cedro Macho	42.0	26.8	16.4	9.8	4.0	0
11 Caoba	22.0	12.4	7.0	4.4	2.0	0
13 Almendro	47.0	24.6	13.2	6.5	1.4	0
14 Manu	94.0	80.0	62.	51.4	35.7	0.4
15 Espavel	78.0	47.6	27.	14.8	3.8	0
16 Compano	32.0	18.1	8.7	4.8	1.4	0.3

	Per cent Moisture Content D.B. (determined by air-oven)									
	Dried in Sun & Weather					Dried in Laboratory 80 % R.H. 73°F.Temp.				
	0 day	8th day	16th day	53rd day	120th day	0 day	8th day	16th day	53rd day	120th day
1 Guanacaste	43.2	24.6	20.2	21.8	--	29.8	20.8	20.4	19.7	18.1
3 Pochote	125.2	102.8	92.5	63.3	31.6	110.4	94.5	87.5	64.0	41.0
4 Cristobal	16.8	14.8	13.4	14.3	--	17.9	16.3	16.3	16.3	16.0
5 Roble Negro	67.	47.5	39.2	25.0	11.5	58.	48.0	35.8	21.5	15.4
6 Laurel	45.6	17.8	15.6	16.7	--	47.	23.8	19.5	18.7	18.0
8 Cenizaro	133.2	40.5	25.0	20.5	--	138.	55.6	32.2	20.8	19.6
9 Sura	62.0	20.8	17.6	20.0	--	32.	22.7	21.8	21.0	20.4
10 Cedro Macho	42.4	22.1	19.7	18.3	--	38.	25.6	23.8	23.2	20.4
11 Caoba	23.	16.6	15.5	16.2	--	21.2	18.2	18.0	17.8	17.1
13 Almendro	49.5	25.4	17.7	20.5	--	37.8	23.0	20.4	19.5	18.0
14 Manu	95.0	76.5	50.0	53.7	32.0	112.2	97.0	92.0	72.8	54.5
15 Espavel	79.0	31.5	18.2	23.2	--	78.5	37.2	25.4	19.5	18.1
16 Compano	32.6	19.3	19.1	19.8	--	29.6	22.9	22.8	22.2	20.8

* 1.5" x 1.5" x 6" Specimens fully exposed



DRYING AND STORAGE OF GRAINS AND BEANS IN THE TROPICS

PROJECT NO. 58 PROGRESS REPORT NO. 1

Date submitted: March 1, 1948

Leader : Norton C. Ives

Location : Institute

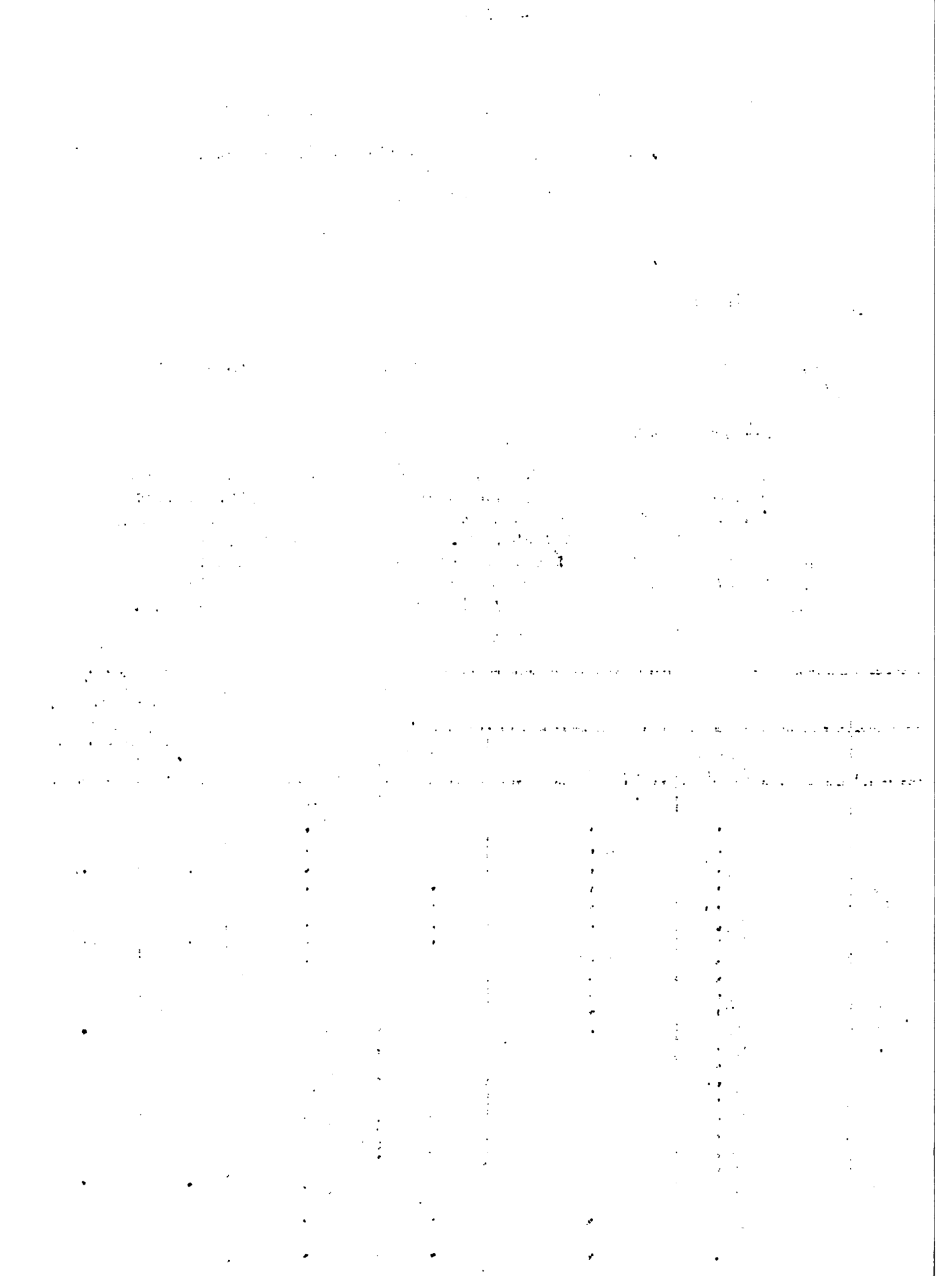
Preliminary studies have been made of the following phases of this project:

A. WEATHER CONDITIONS

Weather conditions at Turrialba station obtained through the cooperation of the United States Department of Agriculture Rubber Station which adjoins the Institute, have been analyzed as to their effect on grain drying and storage. The year 1942 was selected as it appeared average of the records available. Weeks with no instrument interruption were selected. Table I gives weekly mean values as taken directly off the instrument charts by planimeter.

Table I

	WEEKLY MEANS		8 A.M. TO 4 P.M. PERIOD		Grains of Moisture per Cu. Ft. at Dew Point Temperature	
Week No.	Relative Humidity	Temperature	Relative Humidity	Temperature	D.P. Temp.	Grains
2	81 %	70.2°	--	--		
4	85.1	70.8	68.7%	74.3°		
7	81.2	72.9	60.8	80.1		
10	82.7	72.0	65	77.7	66.2	7.1
11	86.2	74.5	68.5	79.2		
13	84.3	72.4	68.2	77.1		
18	83.0	72.6	63.0	79.7		
19	82.6	74.5	63.1	80.9	68.6	7.6
20	83.2	73.7	65.0	82.3		
22	84.8	74.1	67.5	79.8		
24	83.9	74.8	68.4	80.3		
26	86.5	72.4	72.8	78.4		
27	83.5	73.1	65.4	79.0	67.5	7.35
29	83.1	73.8	64.2	79.8		
31	84.3	72.3	69.9	78.2		
33	80.1	72.7	64.7	79.7		
35	85.5	72.9	68.4	81.0		
37	83.6	73.2	64.6	79.6	67.5	7.35
39	83.6	73.2	66.8	79.9		
41	84.5	72.1	71.3	79.4		
43	83.5	73.1	64.6	79.3		
45	80.3	73.0	61.4	79.6	67.4	7.30
47	82.5	71.8	62.1	75.4		
50	84.6	72.5	66.1	76.6		
Average	83.48%	72.92°	66.11%	79.11°		



As will be seen in the above table, weekly means of relative humidity and temperature vary less than + or - 3% and 3°, respectively from the annual weighted averages. Also the moisture density of the air is practically constant throughout the year at 7.4 grains per cubic foot of saturated air or air at 68° F. dew point temperature. Thus, the vapor pressure of the air remains nearly constant throughout the year at 17.3 mm. or 0.33 pounds per square inch.

It is interesting to note that the average sunshine period of the day (8 a.m. to 4 p.m.) averages 80° F. and 66 per cent relative humidity with little variations throughout the year. The damper period of the day (4 p.m. to 8 a.m.) averages 69.6° F. and 91.5 per cent relative humidity. The average daily extremes on clear days are 85° F. high, and 67° F. low. Seldom does the temperature drop below 65° as this is below the dew point temperature and thus would require squeezing out some 4 grains per pound of air for each degree of drop in temperature at a heat release of nearly 1 BTU.

However, during continued dry periods and clear nights temperatures have been recorded below 50° F. Heavy dews occur every night throughout the year, regardless of the other weather conditions.

The high-low extremes of a typical rainy day are 65°-69° F. and 90-99 per cent relative humidity. Any recording instrument will show the humidity reaching 100 per cent almost every night. However, by using the sling psychcrometer a slight depression of the wet bulb is usually possible. Air in the first story of the Administration Building, for example, varies slightly day in and day out throughout the year. The extremes for a typical day are: temperature 72°-75°; relative humidity 78-82 per cent; dew point 67° F. There are no accurate records as to the amount of or per cent of days with sunshine. However, this would tend to vary inversely with the monthly averages of rainfall which are approximately as follows:

January	8	July	12
February	5	August	8
March	3	September	9
April	4	October	9
May	8	November	10
June	11	December	16

These monthly rainfall figures vary greatly from year to year--more than 100 per cent in many cases. The annual average rainfall for this region is right at 100 inches.

To determine the natural drying conditions of any region records should be made to give the following data:

a. Temperature)
b. Relative humidity)--continuously recorded records
c. Hours of sunshine)
d. Times of harvest

Efforts are being made to obtain sets of such instruments.

B. GRAIN MOISTURE CONTENTS

Early in February the Steinlite Moisture Tester was received. This tester operates on an electric resistance principle and in addition to its advantage of speed, it makes possible continuous study of moisture observations on small samples in that the samples are damaged in no way when tested. However, calibration charts are lacking for several of the major tropical crops, such as coffee, cacao, large beans, peanuts, grass seeds, etc.

Plans are under way to make up calibration charts for these special crops and to check feasibility of the tester for use for these crops.

Moisture contents wet basis taken of several grain samples as found in storage seed house at the Institute are give below.

a. Sorghum--Line 8 15.57%

b. Sorghum--Mixed 15.29%

c. Yellow corn, I-452 15.46%

d. White corn, I-451 15.90%

e. Yellow corn on floor of seed house 16.05%

f. Soybeans, Palmeto 15.26%

g. Beans--Soya negro 15.26%

h. Cowpeas--Blue Goose 13.22%

i. Corn from ears harvested twomonths previously and stored in sack hung in field shack 22.06%

These grains had all been stored in small lots, thus being fully exposed to ambient air inside the building, and with the exception of the ear corn, the grains can be assumed to have come to equilibrium with the air. That this is a fair assumption is shown by comparison to the weather data for January which had an approximate mean relative humidity of 78 per cent. The corresponding equilibrium grain moisture content as reported by other workers would be in the region of 15.5 per cent.

It is interesting to note the relatively high moisture content still remaining in well exposed ear corn after two months of storage. Nearly all grain samples collected were infested with insects and the ear corn samples were beginning to mold.

While insects may be controlled by periodic fumigation, molding and relatively rapid respiration will persist in grains with this high moisture content. Therefore, some artificial means of drying such grains must be developed for any storage program.

C. EXPOSED DRYING RATES

Trial runs were made with groups of grains and beans to check the possibility of drying to constant weight and the time required to do so. Moisture contents by air oven method at 105° C. were also compared to Steinlite tester for those grains with calibration charts.

Table II below shows some results obtained in using the air oven method to determine moisture content of whole kernel samples of 100 grams each. The rate of regain was in air averaging 80 per cent relative humidity and 73° F. The figures are indicative and comparative only, but will serve as a guide for future work.

Table II

Oven dried samples
(high degree of exposure, high air velocity)

	Percent Moisture W. B.		Approx. hrs. to reach constant wt. at 105° C.	Rate of "regain" in Lab. air. Days to reach 10% D.B.
	Oven basis	Steinlite		
Sorghum	15	15.57	37	2.5
Corn	13.8	15.46	37	7.0
Terciopelo Beans	13.5	*	55	15.5
Cowpeas	16.8	13.22	37	7.2
Peanuts	10.9	*	32	11.0
Coffee - skin	26.8	*	32	5.5
Coffee - skinless	21.1	*	37	-
Corn I	19.4	21	37	8.0
Corn II	19.6	21	37	7.0

* No charts available

D. SUN DRYING

Highly exposed samples of grain were placed in the sun on clear days and brought into the laboratory at night. While grain may be dried effectively in the sun, it must be protected subsequently from "regain" in moisture from the ambient air. The feasibility of sun drying depends greatly upon the weather and requires a great amount of hand labor. The test run was made during an unusually dry period at Turrialba, and it was not until the seventh day that completely exposed samples of corn were brought down to 11 per cent, only to go back up to 14 per cent fourteen hours after being exposed to air inside the laboratory. Also typical of the problems that would be confronted in the practice was the experience of having the first two trials caught by rain. Mid-day temperatures on clear days of grain were measured as high as 123° F.

A farm size grain drier and one of laboratory size are being designed. Also special storage facilities to provide for the drying, safe storage, as well as such other features as handling grain in sacks are being designed to be constructed and tested experimentally, for the assortment of tropical crops that are now of commercial significance.

SOIL AND WATER RUNOFF STUDIES FROM CONTROL PLOTS ON 16% AND 45% SLOPE

PROJECT NO. 53 -- PROGRESS REPORT NO. 2

Date submitted: March 20, 1948

Leader : Norton C. Ives

Cooperator: Plant Industry Department

Location : Hill at end of road to Animal Industry Section, Section IV

Text of report: All plots are now completed and under systematized observation

There have been two rather large rainfalls, the first, January 14 and 15, 1948, during which for a period of twelve hours it rained 4.25 inches at the plots, and the second, March 12 and 13 with a total fall of 3.83 inches. Data for the plots completed at these times are given in Table I below:

TABLE I - Erosion plot runoff data for storm of January 14, 1948. Rainfall - 4.25" in twelve hours.

Plot No.	RUNOFF % of rainfall	RUNOFF Soil
A-1 - 16% slope	0.12	Trace*
A-2 - " "	0.04	"
A-3 - " "	0.10	0
A-4 - " "	0.025	Trace
B-1 - 45% "	0.11	"
B-2 - " "	0.18	"
B-3 - " "	0.22	"
B-4 - " "	0.12	"

* Water in tanks clear

Erosion plot runoff data for storm of
March 12 and 13, 1948. Rainfall - 3.83"

Plot No.	RUNOFF	
	% of rainfall	Soil
A-1	0.08	0
A-2	0.08	0
A-3	0.08	0
A-4	0.03	0

These observations show quite conclusively that the runoff from this soil in its present condition of tilth and organic matter content is for all practical purposes zero. At the time of both of these storms all plots were bared and cultivated awaiting planting or having just been planted, with the exception of Nos. 3, which are permanently in Bermuda grass.

All twenty-three plots were ready when another rain of 0.22 inches fell on March 17. This was a low intensity rain, so in view of the previous data it was assumed that runoff was zero. However, the accumulated direct rainfall in the tanks averaged around 20% less than that recorded by the rain gauge. This is not accountable for yet. An additional rain gauge has been installed and the tank calibrations thoroughly checked. Further observation and study are necessary to reveal this discrepancy.

Evaporation of free water from the tanks has been measured over a considerable period and the evaporation averages 0.15 to 0.25 cm. per clear day.

These initial observations indicate that this soil is a highly non-erosive soil, as a 4.25 inch rain falling on a bare soil with a 45% slope would certainly cause erosion if the soil were erosive in nature.

Two paramount questions now present themselves for this basic project:

1. What are the physical and chemical characteristics of this non-erosive soil?

2. Will intensive cropping change its erosivity, and what effect will good versus poor cropping practices have on both yield and erosivity?

The design of the experiment will be altered in a definite attempt to answer these two basic questions. The physical and chemical properties of this soil are yet to be determined, although samples for analysis have been sent to Dr. Jenny, head of Department of Soils at California. A soils technician and the necessary laboratory facilities are definitely needed to assist in the proper conduct of this project.

The moisture equivalents of these soils have been determined, using the centrifuge just recently received and are given in Table II below:

TABLE II - Moisture Equivalents of Erosion Plot Soils

Sample	Moisture equivalent
From base of plots	
0- 6"	38.3
6-18"	42.7
18-30"	41.25
30-42"	41.25
From top of plots	
0- 6"	36.4
6-18"	40.5
18-30"	38.2
30-42"	32.6

Much work has been done in the States by Middleton and others in an attempt to correlate physical and chemical properties by quick laboratory tests to the erosivity of a soil.

Middleton reported in 1932 that the dispersion ratio and erosion ration are the only criterion that have been developed for estimating, in advance of actual measurement, the erosivity of a given soil. More recent study has shown very clearly that one of the principal differences between erosive and non-erosive soils is the degree of aggregation of the finer mechanical separates into large stable granules. Such a state or condition exists to a marked degree for these soils.

The ultimate and practical objective of this work, which it is well to keep in mind, is to:

1. Develop a method, if possible, of accurately estimating the erosivity of any tropical soil for field analysis and/or quick laboratory test.

2. For erosive soils to determine the best control methods applicable for the type of cultural practices necessary for the crop.

REQUEST FOR SPECIFIC GRANT-IN-AID FOR AGRICULTURAL ENGINEERING

A. OVER-ALL NATURE OF THE REQUEST

An area of approximately 280 acres has been set aside by the Institute for development of its research and teaching program in agricultural engineering. Practically the entire area is tillable. A part is poorly drained, presenting problems on best methods of use under tropical conditions. At present it is in sugar cane, coffee, and pasture. The area is admirably adapted to this purpose.

It is requested that a grant-in-aid be allocated to the Inter-American Institute of Agricultural Sciences for development of its work in agricultural engineering by supplementation of funds available. The funds should be made available for initial capital improvements and for an annually decreasing allotment over a period of seven years; during this period the Institute will allocate each year larger sums for the support of the project, with the provision that at the end of the seventh year the Institute shall assume the entire budget.

B. FUNDS REQUESTED, TOTAL AND BY YEARS

A total of $537,000 to be used over a period of seven years, with suggested annual allocation as follows:

For fiscal year ending June 30	Amount
1949	$ 257,500
1950	184,500
1951	33,000
1952	26,000
1953	19,000
1954	12,000
1955	5,000
Total	$ 537,000

These funds would be used as indicated below:

1. Capital Improvements

Total requested, $394,000 for erection of buildings, equipment and stocking of buildings, shops and laboratories, and development of the engineering section of the Library. Proposed budget for use of Foundation Funds.

a. Buildings

Building for housing Agricultural Engineering Dept.	$165,000.00
Five residences for staff members at $7,000.00	35,000.00
Six residences for staff members at $5,000.00	30,000.00
Ten cottage units for housing students at $2,500	25,000.00
Total for housing	$255,000.00

b. Equipment

Equipment required for Agricultural Engineering Building and for Experimental Farm Operations	$ 85,000.00
Equipment, plumbing, etc. for 11 houses at $1,500.00	16,500.00
Equipment, plumbing, etc. for 10 student units at $1,000.00	10,000.00
Departmental supplies and stock	7,500.00
Total for equipment	$119,000.00

c. Library

Development of adequate agricultural engineering facilities in the Library	$ 20,000.00
Total for Library	$ 20,000.00
Total funds capital improvement and equipment	$394,000.00

d. Suggested time schedule expenditure on capital improvement and equipment

Year Ending June 30	Budget			
	Buildings	Equipment	Library	Total
1949	$200,000	$75,000	$12,000	$287,000
1950	55,000	44,000	8,000	107,000
				$394,000

2. Operating Budget

Total requested, $143,000 to supplement the permanent Institute funds over a period of seven years. It is proposed that the total operating budget be fixed at $35,000 per year increasing to $50,000 in the second year and to $62,000 in the third and succeeding years. The total contribution to the operating budget from the Institute would increase from $15,000 in the first year and to $62,000 in the eighth year. The proposed annual apportionment from each agency for each year is outlined below.

a. Classified by Origin of Funds

Operating budget for seven years:

For Fiscal Year Ending June 30	Requested Grant-In-Aid from Foundation	From Institute	Total
1949	$ 20,000.00	$ 15,000.00	$ 35,000.00
1950	28,000.00	22,000.00	50,000.00
1951	33,000.00	29,000.00	62,000.00
1952	26,000.00	36,000.00	62,000.00
1953	19,000.00	43,000.00	62,000.00
1954	12,000.00	50,000.00	62,000.00
1955	5,000.00	57,000.00	62,000.00
Totals	$143,000.00	$252,000.00	$395,000.00

b. Classified by Use

It is proposed that the annual operating budget of the Agricultural Engineering Department be set up approximately as follows:

Staff. Five professional grade agricultural engineers	$30,000.00
Staff. Five staff assistants and one secretary	14,400.00
Shop and field labor	5,000.00
Current expenses, supplies for research and student fellowship stipends	9,000.00
Total annual operating budget	$62,000.00

C. THE AGRICULTURAL ENGINEERING JOB TO BE DONE

The Goal: To develop facilities for adequately conducting and cooperating in research investigations under tropical conditions at the Institute.

1. Soil and Water Development and Conservation

   a. Land clearing and development
   b. Soil drainage
   c. Irrigation
   d. Soil erosion control
   e. Land use classification

2. Increased quantity, quality, and efficiency of production of selected food, feed, and fiber crops through the application of power and machinery.

   a. Experiments in mechanization of selected crops. Determination of machine-duty for tropical crops.

      (1) Method of seedbed preparation
      (2) Weed control
      (3) Type tillage in relation to maintenance of crop, or soil tilth, organic matter, etc.
      (4) Special operations for special crops
      (5) Soil, field, and topographic conditions, limitations and special requirements
      (6) Economic feasibility

   b. The development of a sound program for training of machinery operators and service men.

      (1) Sure-fire methods for the type of personnel recruited from Latin America
      (2) Amount of experience and practice necessary
      (3) Physical and personnel facilities necessary

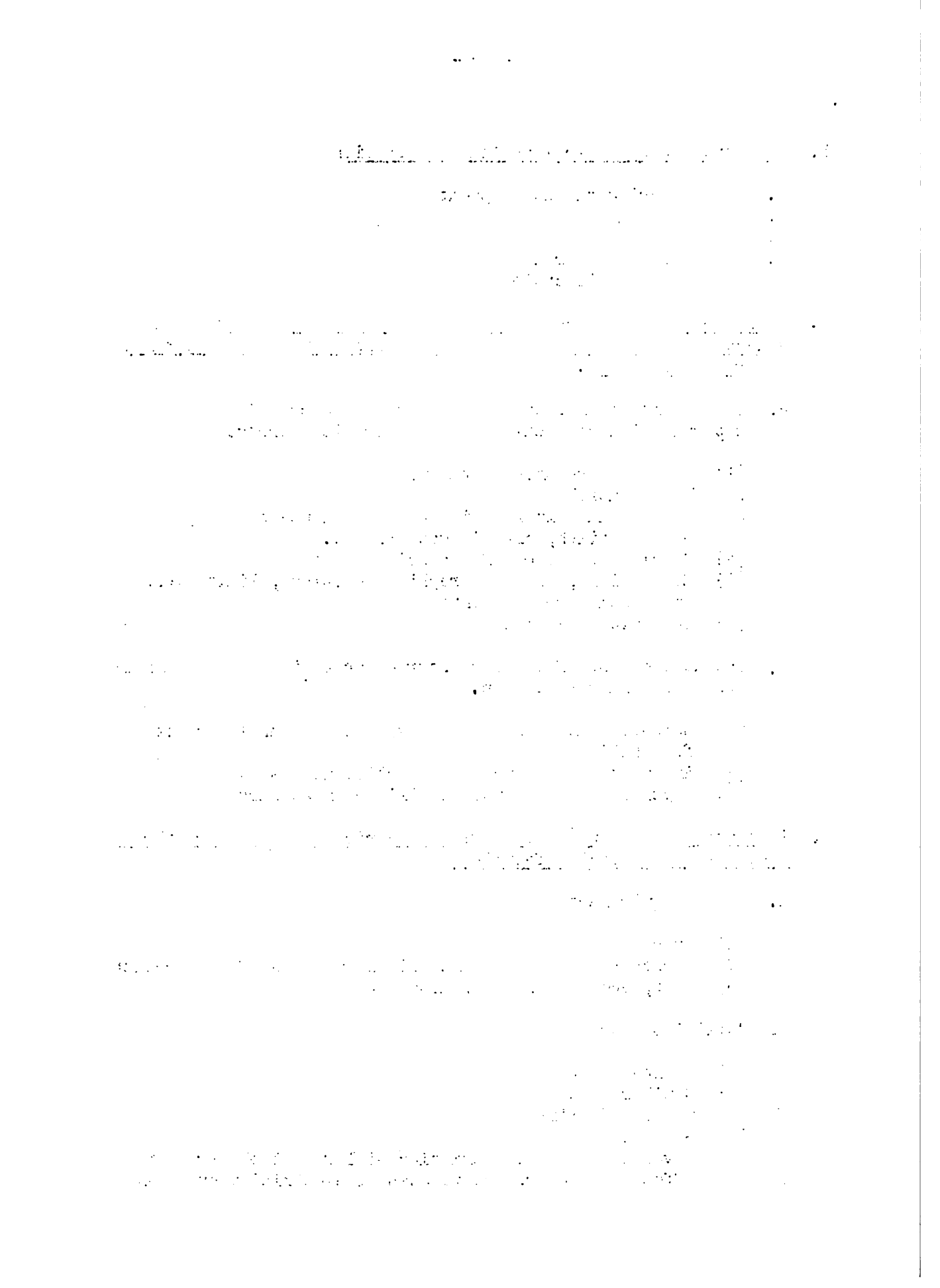
3. Increasing the standard of living of agricultural workers through better farm and living facilities.

   a. House requirements

      (1) Functional
      (2) Structural -- type of materials, methods of fabrication
      (3) Cost, economics, and limitations

   b. Utilities needed

      (1) Sanitary water supply
      (2) Sanitary sewage disposal
      (3) Cooking facilities
      (4) Storage
      (5) Development and transmission of low cost electricity
      (6) Effective and productive uses of electricity on farm.



4. Processing and storage of agricultural crops.

   a. Small farm and inter-farm units
   b. Large size or terminal elevator units
   c. Food and feed crops
   d. Strategic crops

5. Student training program.

   a. Professional

      (1) Graduating an average of four advanced research specialists and ten technically trained agricultural engineers per year.
      (2) To cooperate in supplemental and additional study for colleges and universities of member countries.

   b. Vocational training

      (1) Graduating from the equivalent of a two-year course an optimum of twenty farm mechanics per year
      (2) Special short course work for adult education

D. BASIC FACILITIES NEEDED FOR ABOVE PROGRAM

1. An Agricultural Engineering Laboratory with facilities and equipment for research, teaching, and extension in:

   a. Soil and water development and conservation
   b. Farm power and machinery
   c. Rural structures
   d. Farm and terminal processing bulk storage

2. Research and teaching personnel to adequately cover:

   a. Farm mechanics
   b. Farm carpentry
   c. Farm motors
   d. Farm machinery
   e. Farm processing and storage
   f. Soil erosion control
   g. Drainage
   h. Irrigation
   i. Rural electrification
   j. Hydraulics
   k. Surveying
   l. Engineering mathematics
   m. Engineering physics
   n. Strength of materials
   o. Property of materials
   p. Structural design
   q. Drafting
   r. Machine shop practices
   s. Supervision of mechanical services for the Institute
   t. Soil physics
   u. Soil mechanics

3. Agricultural Engineering Section of the Institute property containing land similar to the range of land conditions suitable for mechanization of the American tropics.

E. THE DEVELOPMENT PLAN

1. Present stage

a. 100 - 247 acres hectare section of Institute land well suited for mechanized farming has been earmarked as agricultural engineering section.

(1) Three years of a five-year cane contract has yet to expire on about two-thirds of it.
(2) The remaining one-third is a low wet area with excellent soil that requires drainage--drainage plan has been fully developed for this area.

b. A detailed plan for agricultural engineering laboratory that fulfills well the above requirements has been prepared.
c. Two research projects in soil and water relations--one in tile drainage; the other, a set of erosion control plots are in operation--and two more detailed projects are being initiated at the present time (1) study of tropical lumbers, (2) grain drying and storage in the tropics.
d. The present personnel and staff in agricultural engineering consists of

(1) Head
(2) A staff assistant in farm machinery
(3) A staff assistant for data taking, recording, and analyzing is necessary laboratory work
(4) A staff assistant in surveying and soil and water relations research

e. Mechanical repair shop with some experienced mechanics, tractor and truck operators, and certain pieces of good mechanical equipment.

2. The immediate goal

a. Build and fully equip an agricultural engineering laboratory.
b. Drain lagoon and otherwise develop for mechanized farming the 100 hectares
c. Purchase basic farm power machinery and equipment
d. Organize and procure basic research and teaching staff as follows:

(1) Of professional grade

(a) Soil and water relations
(b) Power and machinery
(c) Processing engineering
(d) Structures
(e) Vocational training

(2) Staff assistants

(a) Soil and water relations
(b) Power and machinery
(c) Processing
(d) Drafting service
(e) Laboratory technician
(f) Secretary

PROGRESS REPORT

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL LIFE

Julio O. Morales

INTRODUCTION

The program of the Department has been oriented along lines which promise more direct and faster improvement in labor productivity. The problem of low labor productivity is basic in the achievement of higher levels of living and is of concern to all segments of society. Farmers express this problem by saying that their business is unprofitable because of the low productivity of their laborers. At the same time laborers complain about low wages and poor living conditions. Consumers find that prices of basic foodstuffs are too high. Government officials are concerned about the low levels of production and consumption of the country. All these are manifestations of the same basic problem--low labor productivity. To be more specific, prices of corn in Costa Rica as a general rule are higher than in the United States in spite of the fact that farmers in the United States usually make profits producing corn while most Costa Rican farmers get little or no profits. Nor are the Costa Rican corn growers helped by the fact that they pay much lower wages. There is so much more labor consumed to produce the same amount of corn in Costa Rica that its production returns a much lower wage to the laborer, leaving little or no profit to the farmer, even though he sells it to the consumer at a higher price. The plant breeder and agronomist can alleviate the situation by greatly increasing yields, but even such marked contribution would leave the bulk of the situation unsolved.

As labor is not only the principal item of cost of agricultural production (usually accounting for over half of total costs) but also represents the ultimate factor in consumption, there is a very close association between low labor productivity and low levels of living.

Many leaders of the Americas have observed that there is a wide difference in levels and standards of living between the more developed and lesser developed countries of the hemisphere. Some of them have also observed that there is a wider difference between the level of living of the people of the more developed and lesser developed countries of this hemisphere today than there was between that of the Europeans and of the Incas when Columbus discovered America. In other words, the gap is getting wider. It is generally accepted that the resources of the hemisphere should be mobilized to change this trend.

Many American countries have already developed and put into effect programs designed to alleviate this situation. They have also met in conferences to tackle the problem together. Many of those concerned with these programs, however, complain that the social scientists have failed

to provide them with basic principles which should guide the elaboration and operation of these programs.

Considerably more research is needed before the social sciences are able to understand well enough the principles which govern the social and economic evolution of a community let alone of a whole country. Although amazing progress has been made in the last few decades, more basic research on the growth process of a community and its stimulation through education has to be conducted.

Therefore the research program of the Department has been channelled toward the improvement of levels and standards of living along two principal courses: (1) Improving labor productivity by improving man himself and (2) Improving labor productivity through better organization and management of farming enterprises.

Research, to be of value, has to be taken to the people. The Department is primarily concerned with methods of conducting research and the consumers of this type of information are other scientists working primarily in colleges, experiment stations, and other institutions performing similar services. The avenues to convey this information to them are principally technical bulletins and articles, conferences, and resident instruction. Usually a certain amount of resident instruction is required to provide the core around which the others can be tied. Alumni very often can be trusted to carry a good share of the distribution job. In relatively new fields such as economics and rural sociology, alumni help is indispensable. Therefore the emphasis of the Department has been altered to put more emphasis on resident instruction.

RESEARCH PROGRAM

The research program of the Department has been organized around five projects:

A. COMMUNITY PROJECT

The general objective of this project is to determine the economic and social growth process of the family and the community under the influence of a scientifically guided intense educational program. At the same time we shall measure the effectiveness of the methods used in determining the basic problems of the community at any particular time as well as that of the various educational devices used.

The Turrialba community will be studied by a team composed of five scientists in the fields of economics, home economics, sociology and anthropology, health and nutrition. This team has been organized and the work has been divided in the sub-projects which follow:

Rural Sociology and Anthropology Sub-Project

Leaders: Charles P. Loomis
Reed Powell
Julio O. Morales

Objectives

1. To find out what constitutes the community of Turrialba (Delineation of the Turrialba Community).
2. To work out the association patterns of the informal prestige and congeniality groupings, using a sample procedure.
3. To study the institutional structure of the Turrialba Community and the effectiveness of the services rendered.
4. To study the ecological structure of the community.
5. To study the effects of the educational program on the attitudes and opinions of the people.
6. To analyze the class structure of the community.

Progress to date

1. Emphasis has been placed upon obtaining a knowledge of the area and a vision of how best to proceed with the project. In this respect the following have been made subjects of investigation.
   a. Services offered by the Turrialba area
      (1) The town itself
      (2) The surrounding caseríos and barrios (settlements)
   b. Institutions rendering these services and the manner in which they function.

Plans for the immediate future

1. To obtain more knowledge about and a greater vision of the Turrialba area.
2. To formulate, together with other members of the team, a schedule covering the following aspects:
   a. General information
   b. Delineations of locality groupings
   c. Association patterns
3. To delineate the Turrialba Community and work out the association patterns of the people based on the data obtained in the schedule.

Home Economics Sub-Project

Leaders: Marta Coll
Dr. Guillermo Lejarza
Julio Morales
Mrs. Ora Smith

Objectives

1. To appraise the real needs of the community in relation to health, housing, nutrition, family living, and education.
2. To determine which are the most effective methods for obtaining the desired information.
3. To determine which educational devices are most effective for channeling and putting into actual practice a program aiming to improve the level of living of the community.
4. To evaluate the effectiveness of the efforts devoted to the attainment of the objectives of the program and to study the interaction of the Home Economics program with those of other fields.

Progress to date

1. A survey of the literature is under way.
2. A compilation of food analyses and other useful information related to other fields of study is under way.
3. Questionnaires on nutrition, health, child care, family history are being worked out and some have been tested.
4. General information related to the community is being collected.
5. Arrangements are being made with the Health Department of Costa Rica so as to use the services of the doctor of the health unit and the facilities available at the Turrialba Health Center and the Social Security hospital of Turrialba in the study of the health problem.

Plans for immediate future

1. To finish the review of the literature available and compile additional information which may be useful.
2. To gather and get acquainted with information in relation to attitudes, behavior, and other forces which determine group action in the community.
3. To develop questionnaires which will be used in the collection of the data related to the different fields of study included in the survey.
4. To study and collect data on health habits, vital statistics available, medical, dental, and hospital facilities available and the extent to which these facilities are being used, and the reasons for not using them when needed.

5. To help in analyzing the data collected.
6. Upon analysis of the data, to help in channeling properly an educational program based on the needs appraised and the social organization of the community.
7. To develop interest of the community in the work that will be done.
8. To enlist the cooperation of the different organizations and institutions of the community, and support and stimulate spontaneous community programs which seem to contribute to the solution of the problems observed.

Plans for the next year

1. To work with the Sociologist in getting oriented as to the nature of community.
   a. To review previous work of the Department of the sub-project.
   b. To gather additional information such as health, educational and other services available to the people of the areas.
   c. Review bibliography.
   d. To take weekly information on prices of food in Turrialba.
   e. To help plan census work.
   f. To outline Sub-Project with other members of team on the food aspects of Community Project.
   g. To develop health questionnaire together with other members of the team.
2. To execute Home Economics Sub-Project (Health Section)
   a. To contact families in sample and devise plan for them to come to health Unit for their examination.
   b. To assist Dr. Guillermo Lejarza during examinations of the families.
   c. To analyze health data.
   d. To help taking census and analyzing census data.
   e. To proceed with dietary study of families.

Census Sub-Project

Leaders: Julio C. Morales
Jorge León

Objectives

The census of the central district of Turrialba has two purposes:

1. To obtain the necessary information to serve as a basis for other phases of the community project.
2. To gain experience in methods for the census of the Americas of 1950. In relation to this last point this census could provide valuable information on the following points:

   a. How to take agriculture and population census together
   b. How to make, with economy, a de-facto and de-jure census at the same time.
   c. How to coordinate the population, agricultural supplement, and agricultural questionnaires.

Progress to date

1. Cartographic and geographic work
   a. General map of the area (topography, 50 meters contour lines).
   b. Map of the area and division in enumeration areas.
   c. Map of the town and adjoining area, with houses and stores marked.
   d. Sketches (for the use of the enumerators) of all the enumeration area in the rural part of the district, and of the blocks in the urban part.
   e. Delineation of the political boundaries of the district.
2. Questionnaires
   a. These questionnaires were made for the population, agriculture and agricultural supplement sheets.
   b. Questionnaires were discussed with a national organization (Asociación Costarricense de Estadística) which is very much interested in the national census for 1950, with officials of the Costa Rican Secretary of Agriculture, and representatives of different organizations interested in the census (banks, Coffee Board, etc.).
   c. Questionnaires for agriculture were tested with the cooperation of four farmers, and some improvements were made following their suggestions.
3. Instructions
   Complete instructions and definitions for the enumerators were completed covering these questionnaires.
4. Organization
   Arrangements were made with the local education supervisor to use the teachers as enumerators, and permission was obtained from the Secretary of Education to let the teachers work as long as necessary to take the census information.
5. Financing
   Several arrangements were made to finance the census through the help of certain local institutions (banks, Coffee and Sugar Boards, etc.) and the Costa Rican Government. The expenses are estimated at $2,000.
6. Coordination
   a. With local institutions (as those mentioned above).
   b. With international institutions, such as the Inter-American Statistical Association.

Plans for the immediate future

1. To take field information in August.
2. To proceed with analysis of the data.

General Economic Sub-Project

Leaders: Julio C. Morales
Jorge León

Objective

1. To gather basic economic information on the community necessary for the achievement of the general objective of the Community Project, covering:
   a. Physical conditions, such as soils, topography, climate
   b. Management of human and natural resources.
      (1) Land use
      (2) Farm management
      (3) Garden and plot management
   c. Marketing
   d. Balance of the agricultural sector of the economy with other sectors.

Progress to date.

1. Natural conditions
   a. Information on the geography and geology of the area has been collected.
   b. Soils--Very little information available.
   c. Climate--Meteorological data have been collected and partially analyzed. Records on daily rainfall, maximum and minimum temperatures, etc., are currently obtained.
2. Human conditions. The following information has been obtained:
   a. History of settlement since 1530. The historical development of the community has been established along general lines.
   b. Land Use in 1838--Complete information was obtained on the land use for that year (cacao was the main crop, followed by coffee and pastures).
   c. Land Use in 1887--For this year an old map showing the land use was obtained (cacao had disappeared; pastures were predominant)
   d. Agricultural development since the construction of the railroad (cane and coffee more important; considerable production of bananas for few years).
   e. Present land use. A map of the distribution of the eight main cultures was made, and another showing the land tenure. This gives enough material to start a classification of types of land use in the area.

Plans for the immediate future

1. To analyze the data obtained in the census and relate it to data already collected on land use.
2. To study plot and garden management problems of selected families.

B. STUDY OF COFFEE PROCESSING PLANTS (BENEFICIOS)

This is a "work simplification" study to be conducted in cooperation with the Engineering and Plant Industry Departments of the Institute. The general objective is to determine ways of improving the efficiency of coffee processing plants.

Leaders: Julio O. Morales
Jorge León
Francisco Gómez

Progress to date

1. The coffee processing plants (beneficios) of Costa Rica have been located on a map.
2. Information has been obtained on the amount processed by each plant for each year since 1940-41. A detailed study of this information has been made in order to determine fluctuations in volume of operations and the causes for these fluctuations. Very interesting information has been obtained as to biennial bearing and of intensity of yearly variations in yield for the various producing areas of the country. An article will probably be published covering these findings.
3. The information of the Census of Coffee Processing Plants taken in Costa Rica for the year 1936 has been obtained and analyzed. The above information has helped to orient the study along more practical lines and will be basic in the selection of the sample of plants to be studied.

Plans for the immediate future

1. To keep the information on the amount processed by each plant up to date.
2. To conduct a preliminary survey of a number of processing plants to determine the relative importance of the various operations (depulp, ferment, dry, etc.) and of the various items of cost of processing (labor, wood, interest, depreciation, etc.).
3. Select the beneficios to be studied in detail.
4. When Mr. Gómez returns from Michigan State College in January 1949, proceed with the detailed study of each plant.

C. STUDY OF PANELA (RAW BLOCK SUGAR) PROCESSING PLANTS

This study is similar to the one above. Aside from gathering some data on these plants in Costa Rica, the work has been postponed until the student who will use this project for his thesis arrives.

D. STUDY OF RUBBER INTERCROPPING

This project was initiated in order to determine the economic advantages of establishing rubber plantations by intercropping as compared to the conventional way of letting the grass grow between the rows of trees.

Progress to date

In an article entitled "Intercropping Assists Economic Establishment of Rubber Plantations" the advantages and disadvantages of the practice are discussed. This article will be published by the Institute in the near future. The conclusions could be summarized as follows:

1. Intercrops, if properly selected, yield a profit over all costs, which might help to finance the costs on young rubber plantations. In addition some fixed costs of the plantation are spread over a broader base by charging part of these costs to the intercrops.
2. The percent of trees that had to be replanted was lower in intercropped lots. The percent of successfully topbudded trees in lots of three year old trees was much higher in intercropped lots.
3. By June 1947, when trees in intercropped lots had already shaded the entire area, measurements showed that intercropped lots were approximately a year ahead in growth as compared to non-intercropped lots of the same age.
4. Cover crops were more cheaply and readily established in intercropped lots.
5. A saving of $24 in rubber weeding costs per hectare for the period of 1942-46 was secured by intercropping. The principal saving was obtained in the practice of general slashing, costs of other rubber weeding operations remaining about the same.

E. STUDY OF FARM ORGANIZATION AND MANAGEMENT OF COFFEE FARMS

This project will make use of available data kept by some coffee farmers for many years to determine farm organization and management problems through the period for which data is available.

Progress to date

Very useful data has been obtained from three large coffee farms for periods ranging from 15 to 40 years.

Plans for the immediate future

Dr. W. E. Keepper will be primarily devoted to getting this project established on a firm, permanent basis.

F. STUDY OF PRICES OF AGRICULTURAL PRODUCTS

The objective of this study is to determine the seasonal and long-term fluctuations of the principal agricultural products and to determine the relationship in these fluctuations in prices of closely related agricultural products, such as between panela (raw block sugar) and refined sugar prices. The understanding of these fluctuations will help considerably in explaining shifts in organization of farms as well as providing many basic economic facts on many economic aspects, such as effects of seasonal production on prices and storage.

Progress to date.

1. The books of a local wholesale merchant were secured and information on seasonal and long-term price movements of corn, beans, sugar, and panela was taken out for the years 1925-45. A list of other wholesale merchants was made in order to obtain similar data from them.
2. Data on the prices at sales of grain and livestock in Costa Rica have been secured and will be kept up to date.

Plans for the future

Work on the project will be postponed until a student comes who wants to use it for his thesis. Stress during the coming year will be placed on the Community study, the Coffee Processing Plant study and on the study of Farm Organization and Management of Coffee Farms.

INSTRUCTION

We have arrived at the conclusion that instruction in the Department will fall principally in two categories:

1. For students having the basic course work. They will be primarily interested in conducting a research project they may or may not want to use for their thesis here or elsewhere.
2. For students not having the basic course work. An orientation course of three or four months will be given to them, including intensive training in English. (A selection of readings and and discussions has been made for this orientation course. It was successfully used with Mr. Francisco Gómez). After this orientation course, the student will go to a university to take the courses he needs, returning to the Institute after this training prepared to do a research project as indicated above.

   The Department conducted the Statistics Course 202 for all Institute students and some Technical Assistants.

OTHER ACTIVITIES

Dr. Phil S. Eckert, Head of the Department of Economics and Rural Sociology of Montana State College devoted four months of his leave to the selection of readings in Farm Management. These selections were made in order to provide basic information in Farm Management to students of the Schools of Agriculture, such as the ones at Zamorano, Honduras, and Divisa, Panamá. Dr. Eckert is trying to get the selections translated. While the selections were made primarily for use at the practical farm school level, they make good supplementary readings for agricultural college students.

Professor W. I. Meyers' Collection of 139 volumes of selected bulletins, covering a good part of the outstanding bulletins in the field of

Agricultural Economics published during the last twenty years, was secured during the year for the Economics and Rural Life Section of the Institute Library. This addition considerably strengthens this section.

PERSONNEL AND STUDENTS

The Staff of the Department was increased during the year by Mr. Jorge León, Assistant and Miss Marta Coll, Home Economist. Dr. Phil S. Eckert came to the Institute for six months and Dr. Paul Morrison, Geographer from Michigan State College, devoted two months to the study of Land Use of District No. 1 of Turrialba. Dr. Charles Loomis and Mrs. Ora Smith spent one month each at the Institute in connection with the Community Study. Arrangements have been concluded to bring Professor W. E. Keepper of Pennsylvania State College for a whole year. Miss M. E. Lemaire will be with us during June and July to study a geographical problem relating to the Department's research program.

Mr. Francisco Gómez from Colombia and Mr. Reed M. Powell from Michigan State College are the students receiving training in the Department.

COOPERATION

The Department has established cooperative relations with Michigan State College whereby the work of conducting the Sociology and Anthropology Sub-Project of the Community Study becomes a combined responsibility of the Institute and Michigan State College.

During the present year, Miss Hoyt and Miss Thomas from Iowa State College established relations with this Department, and we assisted them in preparing the questionnaire and revising the plans for a Labor Policy Survey to be conducted among a number of Guatemalan coffee growers.

The Head of the Department attended the meetings of the International Statistical Association and of the Commission for the 1950 Census of the Americas held in Washington last September. Close cooperation has been established in matters relating to 1950 Census plans between the Inter-American Statistical Institute and this Department.

Our plans for the Turrialba Census have been strengthened by having all the plans accepted and revised by the Costa Rican Statistical Association. This action has led to the organization of a Technical Committee which will work with this Department in the activities of planning and conducting the trial census. The same close relations have been established with the principal national agencies concerned with the various phases of the Community Study.

Our relations with the Facultad de Agricultura of Medellín, Colombia have been strengthened after the visit of Messrs Carlos Madrid and Gregorio Beltrán of the Institute. Plans are also being discussed to cooperate more closely with the Federación de Cafeteros de Colombia.

PROGRESS REPORT

EXTENSION AND VOCATIONAL EDUCATION

C. R. Kellogg

VOCATIONAL AGRICULTURE

This report will of necessity be brief. It covers preparatory activities only. When the students arrive, they will find ample opportunity for study and practical work in various fields of agriculture. We consider it essential that methods of extension and vocational training be studied and that leaders in these fields be developed.

Animal Industry

Students will be able to carry on both studies and practical work in dairying, with the most modern and suitable buildings, a small but adequate herd of dairy cows, both imported and local, and their work will include the care of the dairy cows and also of the dairy products. A herd of beef cattle will give them practice in the production of meat and in the care of meat animals. Buildings for housing the pigs are completed and the pastures are in order, although the animals have not yet arrived. The poultry houses are complete, the yards seeded to forage crops, and the poultry stock has been ordered and will be here almost any day. A young man, a graduate from the Escuela Agrícola Panamericana will be here very soon to help in the poultry work, all of this providing for specialization in this field for those who wish it.

Plant Industry

1. Vegetables. Over six acres of vegetables, containing varieties from abroad as well as local varieties, are at the disposal of the students of vocational agriculture and other areas are available for planting. Training will be given in the planting and cultivation of vegetables, control of insect pests and plant diseases, marketing, etc., and technical advice is available for those who wish to specialize in vegetable culture.

2. Field Crops. In another part of the Demonstration Farm, experiments are under way on a fairly large scale, to improve the tomato, peanuts, sweet potatoes, potatoes, beans, etc., and these will be available for teaching practical and experimental methods of cultivation of field crops.

3. Sugar Cane, Coffee and Cacao. The grounds of the Institute contain large fields of sugar cane, and several sugar mills in the immediate vicinity offer to the student opportunities for scientific studies and practical work in all phases of the industry. The same applies to the production of coffee and the newly organized work in the planting of the cacao makes possible practice in this field, as well as scientific studies.

4. Grain Crops. Several varieties of sorghum, both for forage and for grain, are being produced, and this should be included in a curriculum for the agriculturist.

5. Fruit Trees. Seedling trees will be ready for budding or grafting by the next season, but in the meantime, there are available various local plants to be used in practice in these arts. A small citrus area has been planted and other fruits will be planted.

6. Grape Culture. Very interesting and important work is being carried on in the cultivation of grapes adapted to tropical conditions, and the students in vocational agriculture may take part in this program.

7. Beekeeping. The only class in vocational agriculture now in progress is a class in beekeeping. Four colonies of bees, purchased locally, are being used for instruction and some experimental work in tropical beekeeping. The class is a voluntary one, outside the regular schedule, and includes two members of the staff and five students.

EXTENSION WORK

A very important phase of the work will be that of extension. This has been initiated in two places. In Cervantes connections have been made with the teacher of an agricultural school. Extension work there should be successful, for the teacher is much interested in practical agriculture and already has a small garden, some animals, poultry and bees, and all that is needed is some help to get improved agriculture into the homes of his students and the other villagers as well.

A second contact has been made with another agricultural teacher in the village of Tuis. This man already has a school garden, in which the students took part during the last term, and is waiting for the students to return from vacation in order to start a new school garden. We took him a large number of seedling plants, which he will use not only for the school garden but for the villagers in neighboring homes.

Visits have been made to a number of other villages and fincas and plans made for additional work.

RURAL DEMONSTRATION CENTER

We regret that the program of the Rural Demonstration Center has not yet begun, as this should prove to be one of the most important and far-reaching enterprises of the Institute. It calls for a complete agricultural and social unit within the limits of the 50 acres to be dedicated to this project. Here the vocational students will be housed and trained, with buildings, animal enclosures, gardens, etc., all on a scale that can be copied by villagers and from which they can also learn the best methods of scientific agriculture. Further, it will be developed into a cultural and educational center for the villagers living within reach, its function being to raise the living standards of the community to a higher level. At the same time it will be an example to be copied by other countries and regions.

The Noche Buena Rural Center will include the following units:

Ten Units to be Developed First

1. Model house for middle class farmer.
2. Students' house.
3. Play fields.
4. Apiary.
5. Improvements of roads.
6. Exhibition and work building.
7. Work with the eight families now residing at Noche Buena.
8. Tool and work shop.
9. Fruit trees to be planted all around the grounds.
10. Equipment for above.

Twelve Units to be Developed Later

1. Shelter and corrals for demonstration animals.
2. Shelter and yards for poultry.
3. Pasture fences for demonstration animals.
4. Fence along the road - make it more attractive.
5. Water supply.
   a. Over all supply
   b. Demonstration use of spring
   c. Demonstration well
   d. Demonstration cistern
   e. Demonstration small hydraulic ram
6. Lighting.
   a. Possible hook-up with Dairy Division of Institute.
   b. Simple rural lighting
      (gas, gasoline, petroleum, electricity, etc.)
7. Model house for small farmer.

8. Demonstration gardens.

9. Strip cropping demonstrations.

10. Steep hillside erosion control.

11. Community kitchen for processing food.

12. Pick-up truck for Center.

LITERATURE

As indicated, much time has been spent in library work, preparation of outlines and guides of study, directions for specific problems, etc., so that when the students arrive, work can begin in the fields which they may choose, either as a class, or individually.

Further, work has been going on in the preparation of a simple and concise bulletin on beekeeping. The first part is now being mimeographed and the rest will soon be done. As soon as this one is finished, a second bulletin, dealing with vegetable gardening will be started and another one on poultry culture. These mimeographed bulletins, in Spanish, will be used in farmers' classes in the neighboring villages.

CONCLUSION

In the face of all the intriguing possibilities for this type of work, it is our regret that more has not been accomplished. A beginning has been made and we hope it will make it easier for Dr. Hatch to start the far-reaching program which he has so ably outlined.

PROSPECTUS OF GENERAL COURSES IN VOCATIONAL EDUCATION

D. Spencer Hatch

Note: All these courses are essentially practical. The laboratories are the fields, homes, gardens, orchards, stables, pastures, green-houses, shops, and the Rural Demonstration Center (as it develops), where students can learn by doing. Only enough class periods will be held to explain fully the different field practices. The training is for general rural leadership, not for specialists in any limited field.

A. AGRICULTURAL ECONOMICS AND FARM MANAGEMENT

1. Management of Farm Enterprises. Considerable time will be spent on the Demonstration Farm with the Manager, foreman, and others in charge of laying out the fields and planning for crops, and study will be made of problems of labor, machinery, and how the necessary work is accomplished.

2. Practical Lectures and Laboratory Periods will be devoted to simple fundamental principles of farm management designed to train students to make wise decisions in regard to organization and management of farms.

Note: Dr. Morales, Chief of the Department of Agricultural Economics and Rural Life, and his staff will give assistance in these courses.

B. AGRONOMY

1. Field Crop Production. Practice in planting and growing the crops on the Institute Demonstration Farm (1135 acres). Includes preparation of the soil, selection and care of seeds, preparation of seed beds, treatment of seeds against pests, planting, weeding, and cultivation of plants, pest-control, harvesting, storage and care of products.

2. Pastures. Development and maintenance: pasture grasses and legumes; fencing.

3. Fruit Culture (Horticulture). Includes similar studies and practices as under Field Crops (Course B-1), also propagation, grafting, budding, and pruning.

4. Vegetable Gardening. Detailed consideration and practice in location and lay-out of gardens; fertilization and tillage, seeds, seedage, garden tools, and general management of gardens.

5. Floriculture. Some practice in growing and selling flowers may be had.

6. Marketing Farm, Garden, and Orchard Products. Includes preserving, canning, and drying. Preliminary step toward the Community Kitchen.

7. Soil Technology. Deals with climatic and other external factors influencing plant growth, and the application of scientific principles in correcting and improving soil conditions. Includes testing of soils, use of farm manures and mineral and organic correctives, compost making.

8. Soil Conservation and Improvement. Contouring, terracing, strip cropping as practiced in area. (Part of this practice will be done in rural Engineering Section). Cover-crops for holding and enriching soil.

Note: The rather large corps of scientists and technicians of the Plant Industry Department is prepared to assist in the above agronomy courses.

C. ANIMAL HUSBANDRY AND DAIRY INDUSTRY

1. Livestock Production.

2. Feeds and Feeding.

3. Dairy Herd Management.

4. Production of Beef.

5. Animal Physiology and Health.

6. Marketing Dairy and Beef Products.

7. Animal Breeding.

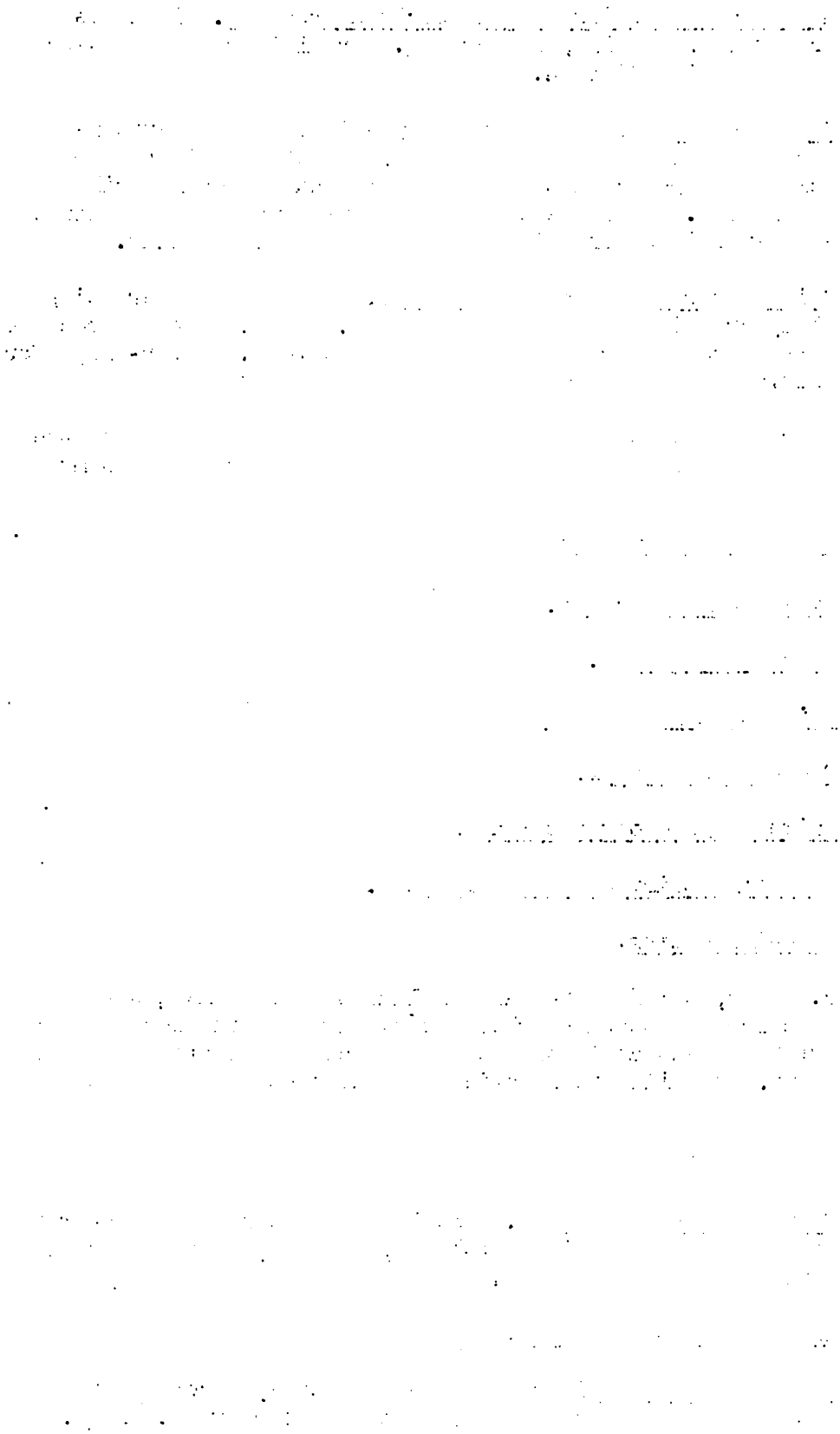
Note: Mr. Rhoad, Chief of the Animal Industry Department, will specify what practice and teaching shall be given under the above headings in accordance with present activities and practices and staff assistance in that Department, and will aid in orienting the students in these practices.

D. POULTRY HUSBANDRY

1. Farm Poultry Production. Practice in planning the enterprise, securing chicks, raising pullets, feeding, housing, culling, sanitation and marketing.

2. Incubation and Breeding.

3. Diseases and Parasites. (Actual practice, according to activities in this division, also directed by Mr. Rhoad.)



E. RURAL ENGINEERING

1. Erosion Control. (Part given under Soil Conservation and Improvement; Agronomy Course 7.)

2. Farm Drainage. (Includes use of dynamite)

3. Clearing of Fields of stones and stumps.

4. Dams and Fish-pond Construction.

5. Water Supply. Simple pumps, small hydraulic rams, elements of plumbing.

6. Sewage Disposal Systems.

7. General Farm Shop. To develop skill in the care and use of simple tools commonly used in a farm shop.

8. Elementary Carpentry. Making of simple equipment and furnishings from wood, wood working, wood finishing, care and use of wood working tools.

9. Household Mechanics. Repair and maintenance of household equipment, refinishing, household painting, soldering; care and repair of electric appliances; floors and floor coverings.

F. RURAL RECONSTRUCTION

Below is given a tentative outline for first part of courses designed to train students how actually to work with, to serve, and to teach farm families. This important section of the training would fit the student, by participation in an actual program, to establish, and conduct small inexpensive rural centers with extension work from them right out among farmers in their home countries, even in isolated places.

1. Rural Demonstration Centers

Preliminary work on the Noche Buena Demonstration Center. Students will help to establish this first Center in Costa Rica. It is adapted after successful centers in India and Mexico.

a. Ten First Steps

(1) Model House for middle class farmer, copiable. This is residence for Director of Center.
(2) Students Houses Two separate small dormitories (Possibly for men and/or women), 4 double-deck beds each, capacity 16 students each. Dining-study room and kitchen -- common for both houses.

(3) Play Fields

(a) Large field for soccer, baseball and general play.
(b) Courts for volley ball, basket ball, and indigenous games.
(c) Children's play grounds.

(4) Apiary

(a) Some 20 swarms of bees (modern hives) in front of Middle Class Farmer's House. (No. 1 above)

(5) Improve Road along center front to nearest Turrialba street, making it easy for walking.
(6) Exhibition and Work Building. To serve for spare-time cottage industries, sales depot, women's and children's department, recreation hall, clinic, reading room and lending library.
(7) Fifteen Families now Residing on or near Noche Buena and Zapote. Get acquainted with them and help them with all possible improvements in houses, gardens, and general living.
(8) Tool and Work Shop.
(9) Plant Fruit Trees all round border after study for positions and best demonstration types.
(10) Equipment for all the above. Students will help in construction of simple equipment.

b. Demonstration Gardens. (Develop as fast as possible.)
c. Build the Fish Pond to Demonstrate Inland Supply of Fish for Food (including dam, stone and gravel beds, and plant food plantings).

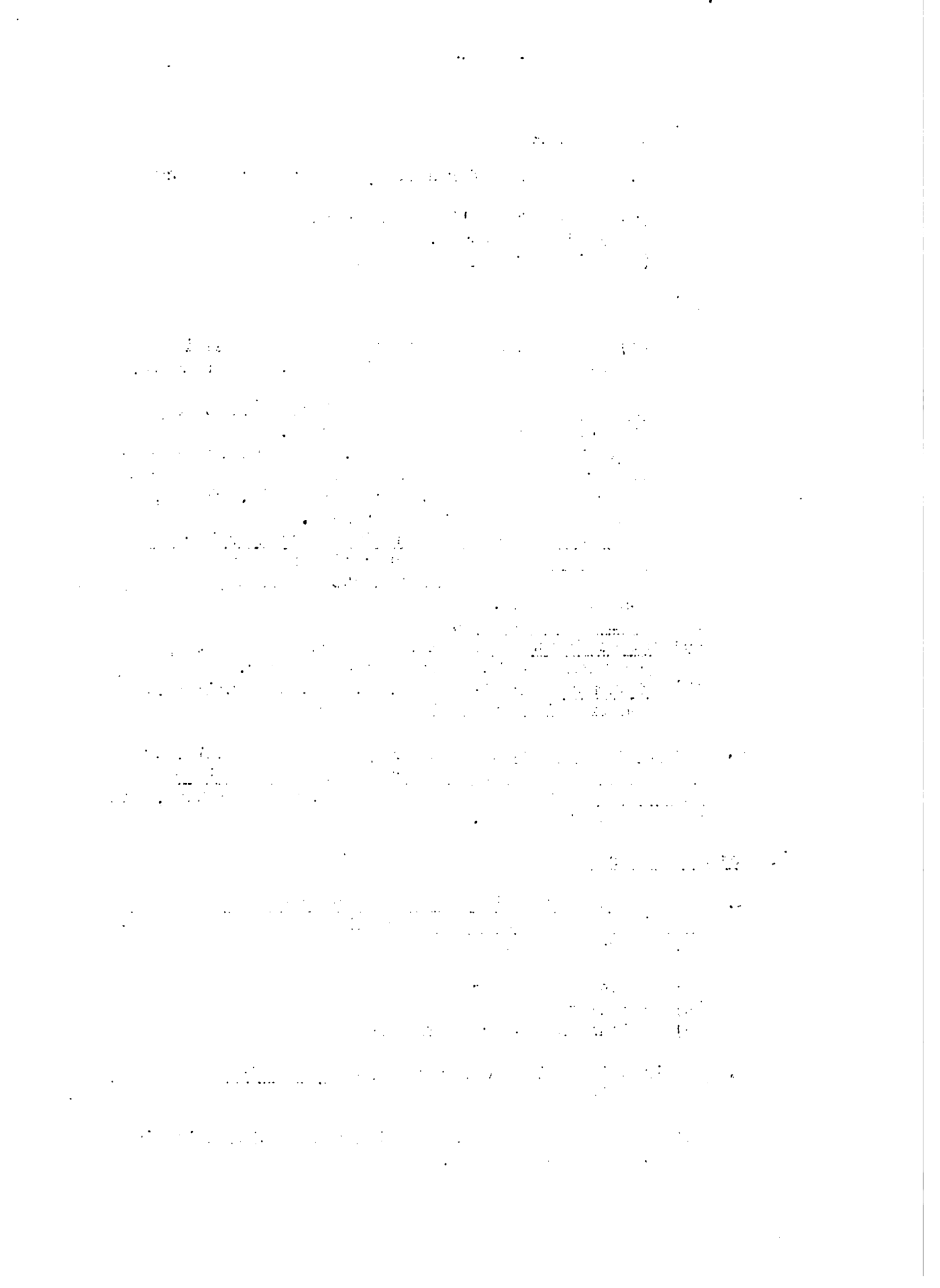
2. Extension Services

a. Continue and multiply contacts, demonstrations, meetings, teaching, and various services (the comprehensive self-help program) with:

(1) Strategic leaders
(2) Families
(3) Neighborhoods or communities

b. Continue investigations regarding Cottage Industries and Arts and Crafts

(1) Bring students into learning and participation in those being started.



c. Apiculture (Includes bees now at Institute).
Constant care and study and further development of the foundation apirary.

(1) Care of the bees.
(2) Transferring bees to modern hives.
(3) Preparing of all equipment
(4) Feeding in wettest months.
(5) Increasing number of colonies by scientific methods.
(6) Extracting, bottling, and marketing of honey.
(7) Helping and teaching village bee-keepers.
(8) Later move all our bees to Noche Buena Center.
(9) Study of established apiaries in other parts.

d. Cooperate with Institute's Agricultural Economics and Rural Life Department. Learn their methods of making surveys. Use, for Extension Service, facts and information revealed in surveys and census of the Turrialba Area.

G. ENGLISH

Since so much of the teaching literature is in English, facilities will be provided for some study of English.

PROGRESS REPORT

ORTON MEMORIAL LIBRARY

Angelina Martínez

There are a few additions that we can report since July 1 of last year.

Personnel has increased by Mrs. Virginia Morales, Assistant Librarian (part time) and Mrs. Emilia Rodríquez, full time clerk.

Additions by purchase.

286 books have been ordered bringing the total of book purchases to 457. Pamphlets, supplies, etc., have also been ordered.

Cataloging.

A few hundred more sets of Library of Congress cards were ordered and some have already been received. 726 more books were fully cataloged. The total of cataloged books now stands at 1,438.

Reference and Circulation.

About 150 reference questions were answered. A cacao bibliography was compiled for the use of the delegates to the Cacao Conference that was held here in October, 1947. Bibliographies on coffee and potatoes are in the process of being compiled.

A total of 1,059 publications have been circulated since our last report, bringing our total of materials up to 2,033.

Journals and Binding.

20 journal subscriptions were added to our subscription list increasing our subscription list to 62 journals.

120 volumes, consisting of 18 books and 102 journals, were bound in San José.

Equipment

Book shelves and library tables. were made at the carpentry shop.

General comments.

1. An informal course in Library instruction was given by the librarian during the first quarter of the school year starting in October.

2. A course in Spanish was also given by the Librarian during the first and second quarters of the school year.

3. A set of rules and regulations was adopted by the Library Committee last December.

TEACHING PROGRAM

A. O. Rhoad

The three major courses of the Institute, namely, Methods of Science, Seminar, and Statistical Methods, have progressed very satisfactorily to date. The following is the list of subject matter treated in these courses to date.

Methods of Science

Seminar

1st Quarter

Cacao Improvement and Program at Institute and in Ecuador	Dr. Allee; Mr. Elgueta; Dr. Robert Fowler
New Aspects of Genetic Breeding of Corn	Dr. S. Horowitz, Venezuela
Hylean Amazon Project, UNESCO	E. J. H. Corner
Tórsalo Control Experiments, IAIAS	A. O. Rhoad
Weed Killers	Milton Gertsch (student)
Costa Rica's Program for Supporting Farm Prices	Dr. P. Eckert

2nd Quarter

Rubber	Dr. Russell Seibert, Rubber Station
Drainage	N. C. Ives
Development of the Sugar Cane Industry	Dr. Julius Matz, USDA
Agricultural Ecology (three sessions)	Dr. G. Azzi, Venezuela
Some Diseases of Coffee	Dr. F. Wellman, USDA
Control of Tórsalo with Commercial Insecticides	A. O. Rhoad
Physiological Reactions of Selective Herbicides	Dr. Ora Smith, Cornell University

Vegetable Variety Trials	E. H. Casseres
Agricultural Production Units in Costa Rica	Padre S. Nuñez, Rerum Novarum
Agricultural Extension in China	C. R. Kellogg
Land Use in Turrialba Canton District I	Dr. Paul Morrison, Michigan State College
Cacao Pod Rot and Other Diseases of Cacao	Dr. A. G. Newhall, Cornell University
Tropical Tomato	J. L. Fennell
Chromosomes of Cacao	Juan Muñoz (student)
Statistical Methods	

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I might also add that a course in cacao has been organized within the Department of Plant Industry and has progressed very satisfactorily. This course is primarily a production course and is admirably fulfilling the necessities of the students as well as the objective of the cacao grant. There is, however, one point of considerable importance in this connection. It is that most of the students are entirely satisfied with just this course and have shown little desire to handle a research project in the subject towards fulfilling the requirements of graduate work.

I am happy to inform you that the courses and their manner of presentation have been satisfactory to the student body. This is primarily, if not solely, due to the excellence of the teaching staff in both experience with the subject, teaching technique, and personality.

There is only one important matter in this connection that requires further effort on the part of the staff. Reference is made to consultation period with project leaders. Not all project leaders are setting aside one hour a week for consultation with their students on matters pertaining to their research projects and other pertinent matters. Perhaps when more students are actively engaged in their own research projects, this matter will correct itself.

INSTITUTE MANAGEMENT

George M. Slater

The annual budget of the Institute might well be used as an index of the extent of the program carried out during the years. Certainly if we look at that for the last two years, we have every reason to be optimistic--1946-47 - $210,000; 1947-48 - $466,000. The largest single item to be pointed out in explaining this wide difference is the $133,000 grant received from the American International Association especially for setting up the Demonstration Farm; and it is significant that this is characteristic of the sort of grants which are likely to play an increasingly important part in the financial program of the Institute unless additional funds can be found from sources other than those which are now readily available. Also to be mentioned are the Esso and Cacao grants totalling $64,000 per year from the Standard Oil Development Company and the American Cocoa Research Committee. Neither of the last two grants was included in the estimated income prepared nearly a year ago.

These increased funds have made it possible to increase facilities and personnel, and have necessitated also some corresponding increases in services on the part of Institute Services, Dormitory Operations and the Business Office which are administered by the Manager. Under Institute Services fall the problems of housing, lighting, power, water, gardener service, transportation, etc. Two cottages and one house have been enlarged during this fiscal year, and two new houses are currently under construction. These are apart from the larger Demonstration Farm building program.

Except for additional output few changes have been inaugurated in the area of services. Electrical current is now furnished for eighteen hours each day. Three new transportation units have been purchased since July, 1947--one station wagon and two pick-up trucks. The trucks were both purchased from funds made available from grants.

The dormitory has served an average of 90 meals per day (in addition to those served to service employees)during the last eight months. Approximately 115 meals per day were served during the month of February. It has been necessary to supply some additional furnishings and equipment both for the kitchen and dining room and for the dormitory rooms. Much of this has been made in our own shops by Institute employees.

In the office it has been necessary to provide secretarial services for a larger number of staff members, and the keeping of separate accounts for each of the several grants along with handling a larger volume of

purchases have made it necessary to employ some new office personnel. The great amount of time required to obtain books and the presentation of new material have made it necessary for us to rely heavily upon mimeograph work. Approximately 50,000 copies of mimeographed material have been turned out this year.

Attached are tables showing the most recent estimates of income and expenses for 1947-48 comparing these figures with the earlier estimated annual budget approved for this fiscal year. It is expected that approximately $14,000 will be available this year for reducing the deficit in the working fund balance which by June 30, 1947, had reached $37,256.15, having been built up over the previous two year period.

The Demonstration Farm income is now expected to be about $14,000 short of the earlier estimate. Concentration on the building program prevented our getting started on a large scale some of the new projects which it was anticipated would yield a sizeable income. Notable among these is the Demonstration Farm Dairy which it was estimated earlier would provide an income of $10,000. Our present estimate calls for an income of $1,600, production having risen from nothing at the beginning of the year to 125 bottles of milk per day during February. Equipment for the creamery still has not been received.

Income from the sale of coffee from the General Institute is somewhat lower than the earlier estimate, while the receipts from the sale of sugar cane more than compensate for the shortage. Also furnishing some income are several items not listed on the earlier report -- sale of vegetables and other products, sale of medicines, sale of rubber seed from the Panama Sub Station, transfer of building materials, etc., to the Demonstration Farm, and miscellaneous receipts.

INTER-AMERICAN INSTITUTE OF AGRICULTURAL SCIENCES

ESTIMATED INCOME FOR THE FISCAL YEAR ENDING JUNE 30, 1948

	Demonstration Farm	General Institute	Total
Governmental Quotas			
Payments to December 31, 1947 - $163,104			
Estimated Additional Payments - 26,896[a]	$	$190,000	$190,000
American International Association Grant	133,000		133,000
Esso Grant[b]		9,500	9,500
Cacao Grant		50,000	50,000
Farm Income and Other			
Sale of Coffee		1,800	1,800
Sale of Sugar Cane		32,000	32,000
Sale of Vegetables (Tomatoes)	65	1,500	1,565
Sale of Cattle		10,000	10,000
Sale of Milk	1,600		1,600
Sale of Eggs	10		10
Sale of Poultry	50		50
Sale of Other Products	30	200	230
Pasture Rental	175		175
Meals and Laundry		11,000	11,000
Sale of Medicines		2,200	2,200
Panama Rubber Station (Seed, etc.)		1,250	1,250
Miscellaneous Receipts		13,000	13,000
Transfer of Materials and Services to Demonstration Farm		4,000	4,000
Esso Administrative Allowance[c]		850	850
Cacao Administrative Allowance[c]		4,080	4,080
TOTAL (March 25, 1948 Estimate)	$134,930	$331,380	$466,310
Original Estimate (Annual Budget)	$148,805	$276,780	$425,585

a. $42,465 is now due by the several contracting states.
b. $ 5,100 of Esso Grant is in direct salary and expense payments and not indicated here.
c. Shown as income since the total amount of the grant is shown as spent in the statement of estimated expenses

INTER-AMERICAN INSTITUTE OF AGRICULTURAL SCIENCES

COMPARATIVE STATEMENT OF BUDGETED EXPENSES AS COMPARED WITH ACTUAL EXPENDITURES TO DEC. 31, 1947 AND ESTIMATED ANNUAL EXPENDITURES (MARCH 25, 1948)

	Annual Budget	Actual Expenditures Dec. 31,'47	Estimated Expenditures to June 30,'48	Comments
Office of the Director	$13,650	$ 7,989	$15,000	2 Secretaries for five months
Animal Industry Department	52,641	18,169	50,000	Saving on Student $600
Plant Industry Department	42,103	23,905	49,000	
Agricultural Engineering Dept.	23,000	9,050	18,500	No students, $3,000 budgeted
Economics and Rural Welfare	17,020	4,517	12,750	Includes Jeep, $50/mo. to Gomez
Vocational Education & Extension	16,200	2,098	7,500	Saving on students $4,200
Institute Services	30,035	13,437	25,000	Staff salaries in Office
Farm Operations	16,763	6,466	14,000	Delay in harvesting cane
Dormitory Operations	15,140	8,717	17,500	Additional cacao students
Library	7,950	3,437	7,950	
Office Expenses	13,950	11,513	22,000	$7,500 of this budgeted to Voc. Ed. and Inst. Services
Medical & Social Security	2,400	1,243	3,000	New old age insurance
Miscellaneous	3,100	1,271	3,600	
Travel	12,000	5,538	12,000	
Equipment				$26,303 AIA funds to be spent or carried forward. $6,500 saving due, Lab. Eq. charged last year
Inst. & Voc. Ed. $23,102				
Demonstration Farm 26,303	49,405	8,888	42,905	
Construction (Inst. & Voc. Ed.)	19,500	5,017	22,500	Elgueta's house enlarged, etc.
Construction(Demonstration Farm)	49,658	30,062	49,658)	
Special Projects			)	
Esso Project	9,500	2,067	9,500)	(To be spent or balance carried
Cacao Project	50,000	4,153	50,000)	(forward
TOTAL-COSTA RICA	$444,015	$167,537	$432,363	
Panama Sub-Station	3,000	1,809	3,000	
Washington Office	17,040	8,595	17,040	
GRAND TOTAL	$464,055	$177,941	$452,403	
To Deficit in Working Fund			13,907	
Total Available			$466,310	

INTER-AMERICAN INSTITUTE OF AGRICULTURAL SCIENCES

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