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Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

CIAT

CASSAVA PROGRAM REVIEW CONFERENCE

CENTRO INTERNACIONAL
DE AGRICULTURA TROPICAL

January 10–12, 1972
Cali, Colombia

Programas de Adiestramiento

APARTADO AEREO 67-13
APARTADO NAL. 737
CALI - COLOMBIA
CABLES: CINATROP

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL

0052-DCAG.

March 1, 1971

Dr. David J. Rogers
Professor of Biology
Taximetrics Lab.
University of Colorado
Boulder, Colorado 80302

Dear Dr. Rogers:

I appreciate your letter of December 31, 1970 concerning collaboration in the classification of the yuca collection which we have here at CIAT. At the present time we are in the process of making some decisions in regard to the direction of our program in yuca and in the relative near future should be able to more clearly define any areas of collaboration which might be possible. We certainly are interested in any aid that we can secure in classification of the material that we have collected. We have approximately 2500 clones of M. esculenta and will be collecting more material in the future. The material which we have collected comes from Panama, Venezuela, Ecuador, Peru, Puerto Rico, in addition to Colombia.

We are making some broad classification of the material and taking notes on many of the plant and root characteristics in addition to some laboratory work which is being done in collaboration with the Universidad del Valle. We would appreciate very much receiving a copy of the comprehensive classification system which you have submitted for publication in Economic Botany. It would also be quite helpful to us if you would be able to send us copies of some of your publications concerning yuca classification inasmuch as our library facilities are extremely limited and we do not have copies of most of these publications at the present time.

We have a copy of your presentation made at the International Symposium on Tropical Root Crops in Trinidad. It is interesting to see that you do not use floral characteristics in your classification system of the cultivars. While it is true that not all

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cultivars will produce flowers it appears to us that this valuable characteristic should not be overlooked in distinguishing between cultivars which produce flowers. We have also found considerable variation in the number of lobes on the leaves within a cultivar. This variation is accentuated by any stress such as drought or other factors, but even in plants grown under good conditions, it is not uncommon to find plants with leaves having 7 to 9 lobes. In this case, do you use an average as determined by the count of a given number of leaves or do you use the number of lobes which occurs most frequently?

I am sure that we will be able to define some areas of collaboration in the near future and it would perhaps be facilitated if we would be able to start taking our field notes in a way that might fit into your classification system as soon as possible. Thus it would be helpful if we have as much information concerning your programs as possible and we could then later define more clearly areas of collaboration which would be of mutual benefit. It would also help eliminate the possibility of neglecting to take certain observations which should be made at a particular stage of plant growth.

As soon as we have more clearly defined within our own organization some of the aspects in our yuca project, I shall be contacting you again.

Sincerely yours,

Eduardo Alvarez-Luna
Assistant Director
Plant Sciences

RT/bmh

cc.: Dr. R. Thompson

January 21, 1972

Dr. U. J. Grant, Director
CIAT
Cali, Colombia

Dear Jerry:

As is true of any good conference, the participants go away with ideas that they didn't get sufficiently well formulated to present or talk about at the conference. This was certainly true in my case, where all the discussions were meaningful, stimulating, and exciting. I am also much instructed by the directions you can take, and the restrictions on work which are still with you, even though the raw figures of the money granted from Canada sound as though you could mount almost any program and finance it.

Having heard your own discussions, and those of CIAT staff members, I am aware that you will have to work within the framework you presented, without any frillsor peripheral type research. This being the case, I would hardly wish to insist that one of the proposals I had something to do with, namely systems analytic approach, be put at the top of your agenda for funding. It is true that systems approaches have never been applied in any big way, formally, for agricultural development, and have, therefore, never demonstrated that this type of approach would pay off. On the other hand, we could argue that because the approach has been employed in other than agricultural endeavors with success, it should be at least interesting to try it with a new endeavor, like cassava development.

With the above ideas in mind, it occurred to me (after the conference was over) that it might be instructive to treat the idea of systems analytic approach for cassava development as a type of developmental research, not to replace or interfere with your own set of directions, but running parallel to them, in hopes of demonstrating the practicality of systems analysis for agricultural development in general. I am personally persuaded that the approach will be valuable, but do not wish to try to persuade you except by demonstrated significance.

Hopefully, you will concur that the approach is useful, but this does not intend that you should also have to fund any of the work necessary for the demonstration. My colleagues and I would be pleased to work on systems approaches with funding from other sources, provided we have your approval, and willingness to let the work proceed at Cali. Time involvement is still quite indefinite, of course, but I do not expect that we would be working more than two to three months on the project. (At least at the beginning, to reach some objectives).

At this stage of the game, I will not go into any detail about what will be done on a day-to-day basis, but am asking whether the idea has any appeal to you. Given your positive response, it will then be time to more fully describe the systems approach objectives, anticipated results, and methods to achieve them. We would prepare a document which goes into detail on the procedures, let you look at it for approval, and then use the document as a grant instrument for funding. In addition to my own work on the project, Dr. Charles Slater in the Graduate School of Business at the University of Colorado, will be coprincipal investigator. Dr. Appan, whom you met, and one other young man, Gilbert Hersh, will also be involved.

Looking forward to your response, and thanks for a very fine time in Cali.

Sincerely,

David J. Rogers
Visiting Scholar

12/22/71

Dear Pat:

In response to yours of the 6th, I would like for us to take up the probability of funding our information exchange program with IRDC, either independently of, or in conjunction with CIAT. I have not done anything further than my original proposal to members of the council, because there seemed no way to get funding for the work.

Now, with Canadian IRDC, there may be a chance to proceed. Since Dr. Nestel will be at the meeting, I think it would be an ideal time to discover the Canadian interest.

I don't know what Frank Martin will bring up, but there seems to be a growing need to get the Society to put itself on record against unrestrained exchange of propagating material. This should include all our crops, not just cassava.

We received your Christmas card, and appreciate it very much. Looking forward to seeing you.

Sincerely,

David J. Rogers
Visiting Scholar
(on leave from U. Colo.)

INTERNATIONAL SOCIETY FOR TROPICAL ROOT CROPS

CABLE: STOMATA
Department of Crop Science,
The University of the West Indies,
St. Augustine,
Trinidad, W.I.

6th December, 1971

Dear Dave,

I understand from Dr. Barry Nestel that you have been invited to attend the Cassava Program Review Conference at Cali in January next year.

Except for Drs. Plucknett and Leon the entire Council of the International Society for Tropical Root Crops appear to have been invited to this meeting. I am, therefore, proposing that opportunity be made to hold a Council Meeting on the evening of Monday 10th.

This should provide an opportunity for reviewing the plans for the Society up to 1973 and to develop ideas for the third Symposium.

It is my intention to invite Drs. Hahn and Nestel to attend the meeting in view of their likely involvement in the third Symposium.

It would be helpful in planning this meeting if you would submit any items for inclusion in the agenda.

With kindest regards,

Yours sincerely,

Patrick

P.H. HAYNES
(Secretary)

Dr. D.J. Rogers,
Department of Biology,
Armory 101,
University of Colorado,
Boulder, Colorado 80302, U.S.A.

MANIHOT RESEARCH AT THE TAXIMETRICS LABORATORY

UNIVERSITY OF COLORADO, BOULDER, COLORADO USA 80302

RESEARCH TEAM:

Dr. David J. Rogers (Director), Professor of Biology, Chairman of the Division of Population Studies, Dept. of Biology, Univ. of Colorado.

Dr. Henry S. Fleming

Dr. S. G. Appan

Dr. Gilbert N. Hersh

Some of the major areas of current research on Manihot at the Taximetrics Laboratory are briefly described below.

1. COMPUTER-AIDED CLASSIFICATION OF THE CULTIVARS OF MANIHOT ESCULENTA.

The large number of variants of this cultivated species, differing in some cases only in one biochemical property, maintained only by intercession of man's conscious cultivation, exhibit an apparent continuum in their phenotypic properties; in contrast to members of wild species which are constantly subjected to selection pressures maintaining a high frequency of genotypes manifesting phenotypic properties varying within specific limits conferring maximum fitness. In order to discover constellations of cultivars reflecting natural relationships within the cassava gene pool, powerful computer-aided procedures for analyzing the multidimensional variation embodied in large number of phenotypes with respect to numerous phenotypic attributes were developed at the Taximetrics Laboratory. By employing these procedures the cultivars constituting the cassava gene pool were divided into two major subdivisions. Below this category the cultivars are clustered into 19 world-wide types. This computer-aided classification provides a sound framework for 1) developing an universal catalog of cassava cultivars describing their economically significant phenotypic attributes; 2) efficiently designing cytogenetic investigations to understand the karyological mechanisms of differentiation in this group of cultivars; 3) building computer banks of phenotypic and cytogenetic information so as to enable breeders to search and pick appropriate genetic stocks by manipulating the bank.

2. COMPUTER-AIDED DELIMITATION OF THE CLOSED GENE POOLS OF THE GENUS MANIHOT.

The numerous wild species of Manihot represent a rich practically unexplored and unexploited reservoir of potentially valuable genetic variability. In order to put this wealth of wild genetic potential to proper use, it would be necessary to undertake a systematic evaluation of the biological properties of the wild Manihot species especially the qualities significant from a cassava crop improvement point of view. Closed gene pools, being the largest interbreeding units in natural populations, represent the most

efficient sampling units for evaluation studies. Employing the computer-aided Taximetric methods developed at the Taximetrics Laboratory the closed gene pools which together constitute the entire genus Manihot have been delimited. Their geographical domains have been delineated, and their phenotypic attributes including morphological features, ecological adaptations, and preliminary cytogenetic and biochemical properties have been defined. The computer output of the similarity graph clustering program provides graphic indications of the patterns of the genetic structure of the populations, a knowledge of which is critical in designing plant breeding strategies. The 96 closed gene pools so described includes 12 newly discovered ones.

3. COMPUTER INFORMATION BANK OF MANIHOT GERM PLASM RESOURCES.

The data generated in the above two projects are being stored in computer banks in order to facilitate an efficient use of this information in the second phase of the envisaged program ie. intensive cytogenetic studies and evaluation of the genetic potential of the gene pools. The bank is accessible to to easy and rapid retrieval of pertinent data through any of the three modules of PROGRAM TAXIR designed for use in CDC 6400 or IBM 360 computers. This bank is intended to serve as a central source of Manihot germ plasm information for cassava workers all over the world. When completely built and becomes operational it would have several applications such as:
1) This will enable a worker to identify the closed gene pool or the introgressive hybrid population which his experimental material represents, and in case of cassava cultivars to relate his material to any one of the 19 world-wide basic types in the Manihot esculenta gene pool.
2) Will enable a breeder to search the bank on any one or a combination of criteria (cytogenetic, ecological, biochemical etc.) and pick the germ plasm possessing the desired genetic potential.

4. SYSTEMS ANALYTIC STUDIES OF CASSAVA-BASED NOURISHMENT GENERATING SYSTEM CAPABLE OF FUNCTIONING IN ECOLOGICALLY & ECONOMICALLY IMPOVERISHED AREAS.

Ecological deterioration imposes major constraints on the capability of the biosphere to generate nourishment to support mankind. On the one hand we are realizing that internal combustion engine, inorganic fertilizers, and pesticides are major causes of todays environmental pollution, whereas in the developing countries the green revolution places heavy emphasis on promoting the use of these. Economic impoverishment is the primary obstacle in developing countries in transforming the traditional to modern agriculture for unlocking the food potentials, but when modern technology is employed it tends to promote indiscriminate use of the causal agents of pollution leading to further and further deterioration of our environment and thus we get trapped in a vicious cycle. In this perspective, systems with potentialities of efficiently generating nourishment from deteriorated environmental pockets and/or under economically impoverished conditions are bound to become increasingly valuable to support man's enlarging need for food. The cassava-based nourishment generating system appears to be capable of efficiently generating protein rich human sustenance from depleted and disrupted ecological niches under primitive conditions of economy and technology. A preliminary evaluation of this system indicated that in certain areas of South America the natives take advantage of the ability of this crop to produce abundant carbohydrates from ecologically depleted areas, and enhance the protein content through a processing system involving micro-organisms. Thus conventional protein rich human sustenance, acceptable without any objection to the palate (the activity of the microorganisms in fact is reported to give a meaty flavor to the otherwise bland product)

is generated from economically and ecologically depauperated areas. The system appears to be remarkably efficient in that the cyanogenic glucosides present in cassava roots are reported to be linked by chemical pathways with protein and as such it is probable, but should be demonstrated, that this ingenious system innovated by American Indians modifies the poison into valuable protein thereby not only detoxicating the roots but also enhancing the protein content. Such systems of microbial conversion of carbohydrates into protein is reported to be 15 times more efficient than beef, 12 times more efficient than poultry, and 4 times more efficient than milk. The system appears to have tremendous potential, and the Taximetrics Laboratory is in the process of outlining a research project for intensive computer-aided systems analytic studies of this system and to build models based on it to elucidate the problems, feasibility, scope, efficiency, and values of systems with potentialities of making the ecologically deteriorating biosphere support human populations.

A.I.D. PROJECT. PREPARATION OF A PLAN FOR THE ORIENTATION OF FUTURE RESEARCH ON CASSAVA.

The Taximetrics Laboratory is collaborating with the University of Georgia in preparing a report analyzing the potentialities, limitations, and scope of cassava as a food and industrial crop, and recommending a plan for the orientation of future research in this crop.

SOME PUBLICATIONS ON MANIHOT FROM THE TAXIMETRICS LABORATORY:

Appan, S.G. 1969 - North American species of Manihot delimited by computer-aided Taximetric methods. Doctoral dissertation, Univ. of Colorado, Boulder, Colorado.

Appan, S.G. & D.J.Rogers 1969 - Taximetric methods for delimiting biological species. XI International Bot. Congress, Seattle. Abstracts of papers, p. 5.

Appan, S.G. & D.J.Rogers 1970 - The closed gene pools of Manihot delimited by computer-aided taximetric methods to aid utilization of the wild genetic wealth in cassava improvement programs. Tropical Root & Tuber Crops Newsletter 3: 16-18.

Appan, S.G.; D.J.Rogers; G.N.Hersh; and H.S.Fleming 1970 - A strategic program for genetic engineering of cassava. Proc. Second International Symp. Tropical Root & Tuber Crops 1: 79-82.

Fleming, H.S. & D.J.Rogers 1970 - A classification of Manihot esculenta using the information carrying content of a character as a measure of its classificatory rank. Proc. Second International Symp. Tropical Root & Tuber Crops. 1: 66-71.

Fleming, H.S.; D.J.Rogers; & S.G.Appan. In press - Computer information bank of Manihot germ plasm resources. Tropical Root & Tuber Crops Newsletter.

Rogers, D.J. 1953 - Variation in Manihot utilissima and related species. Year book of American Philosophical Society. p. 166-168.

Rogers, D.J. 1963 - Studies of Manihot esculenta Crantz and related species. Bull. Torrey Bot. Club. 90: 43-54

Rogers, D.J. 1965 - Some botanical and ethnological considerations of Manihot esculenta. Econ. Bot. 19: 369-377.

Rogers, D.J. 1967 - A computer-aided morphological classification of Manihot esculenta Crantz. Proc. International Symp. Tropical Root Crops, Trinidad. 1: 57-80.

Rogers, D.J. 1969 - Manihot, Man, and Computing machines. Summary of the Fairchild lecture. Fairchild Tropical Garden Bull. 24: 11-13.

Rogers, D.J. & S.G.Appan 1969 - Taximetric methods for delimiting biological species. Taxon 18: 609-624.

Rogers, D.J. & S.G.Appan 1970 - untapped genetic resources for cassava improvement. Proc. Second International Symp. Tropical Root & Tuber Crops. 1: 72-75.

Rogers, D.J. & S.G.Appan In press - Monograph of genus Manihot.

Rogers, D.J. & S.G.Appan In press - Chapter I in Plan for the orientation of future research on cassava (Manihot esculenta). Report to the Agency for International Development.

Rogers, D.J. & S.G.Appan In press - Cassava-based nourishment generating system capable of functioning in ecologically and economically impoverished areas. Tropical Root & Tuber Crops Newsletter.

Rogers, D.J. & H.S.Fleming 1964 - A computer program for classifying plants: II. A numerical handling of non-numerical data. Bioscience 14: 15-28.

Rogers, D.J. & H.S.Fleming In press - A computer-aided classification of Manihot esculenta cultivars. Econ. Bot.

Rogers, D.J.; H.S.Fleming; and G.F.Estabrook 1967 - Use of computers in studies of taxonomy and evolution. in Th. Dobzhansky, M.K.Hecht, and Wm.C.Steere (eds.) Evolutionary Biology 1: 169-196.

Rogers, D.J. & Milner M. 1963 - Amino acid profile of manioc leaf protein in relation to nutritive value. Econ. Bot. 17: 211-216.

Mrs. Washington
SF PA 364 1921

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CABLES: CINATROP

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL 355-DCAG.

December 1, 1971

Dr. David J. Rogers
c/o Food Research Institute
Stanford University
Stanford, California 94305
U. S. A.

Dear Dr. Rogers:

We are pleased that you will be able to participate in the Cassava Review Conference at CIAT in January 1972.

Your recommendation of Dr. S. G. Appan is greatly appreciate. We have invited him and have received his acceptance to attend and participate in the Conference.

Also we appreciate your calling to our attention the name of Dr. Ir. G. Ha. Bruijn. However, the limitations of funds and the fact that Dr. G. G. Bolhuis of Wageningen has accepted our invitation to the Conference, does not permit us the possibility of extending an invitation to Dr. de Bruijn for this event.

I like to make reference to your request to spend additional time in Colombia. We will be very happy to assist you with travel arrangements and to establish the necessary professional contacts with our colleagues of the Colombian Agricultural Research Institute stationed in the North Coast of Colombia, to facilitate your travel and collecting trips. However, I regret to inform you that we are not in the position to offer you additional support for this project.

Your contribution has been received and we thank you for your prompt attention. If the contributions from other participants arrive on time, we will circulate these in advance.

Please find attached a tentative agenda for the Conference and a general information sheet.

We look forward to seeing you at CIAT in January and believe that with so much cassava expertise asembled, the meeting will be interesting and fruitful.

With my best regards, I remain,

Sincerely yours,

Eduardo Alvarez-Luna
Director, Plant Sciences

Encl.
cc: Dr. B. Nestel: IDRC
Dr. F. Byrnes: CIAT

TENTATIVE AGENDA

CASSAVA PROGRAM REVIEW CONFERENCE

Centro Internacional de Agricultura Tropical

January 10-12, 1972

Cali, Colombia

First Day

Welcome and introductory remarks		U. J. Grant
Is Cassava Needed?		G. I. Trant
The Future Role of Cassava	Discussion Leader-	W. O. Jones

REVIEW OF CURRENT CASSAVA PROBLEMS AND ACTIVITIES

Productivity Factors: Discussion Leader- J. Cock

- Physiological potential
- Cultural practices
- Fertilization
- Crop Protection

Product Characteristics: Discussion Leader- J. Maner

- Chemistry
- Human nutrition
- Animal nutrition
- Industrial uses

Varietal Improvement: Discussion Leader- D. L. Jennings

- Germplasm
- Techniques
- Varietal evaluation
- Dissemination

Second Day

Continuation of previous day program

Agricultural Engineering: Discussion Leader- _____

- Production
- Harvesting
- Post-harvest

Socio-Economic Factors: Discussion Leader- M. Silvestre

Production
Marketing
Public policies
Variety and product acceptance

Review of other topics

The Role of International Centers in Agricultural Development — F. C. Byrnes

CIAT'S ROLE IN THE INTERNATIONAL IMPROVEMENT OF CASSAVA

Objectives of CIAT Cassava Program	J. Cock
Utilization of Cassava	J. Maner and A. Pradilla
Germplasm and Quarantine Restrictions	R. Thompson

Third Day

Breeding	E. Alvarez-Luna
Physiology	J. Cock
Agronomy	R. Thompson
Soils	J. Spain
Plant Pathology	G. Galvez
Entomology	A. Villacorta
Weed Control	J. Doll
Agricultural Economics	P. P. Andersen
Documentation and Library	F. Monge
International Activities and Programs	F. C. Byrnes
Final Discussion	

A visit to the CIAT farm will be made Tuesday afternoon or Wednesday morning, depending on the weather.

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CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL

Information Sheet

CASSAVA PROGRAM REVIEW CONFERENCE

DATE: January 10-12, 1972; please plan your travel so as to arrive Cali no later than Sunday evening, January 9.

PLACE: Hotel Intercontinental Cali, Cali, Colombia.

SPONSORS: This Conference is sponsored by the Centro Internacional de Agricultura Tropical (CIAT) with the support and assistance of the Canadian International Development Agency (CIDA) and the International Development Research Centre (IDRC).

ADDRESS: CIAT, Apartado Aéreo 67-13, Cali, Colombia. Cables: CINATROP
Hotel Intercontinental Cali, Cali. Cables: INHOTELCOR

AIRLINE TICKETS: Round-trip, jet, economy class tickets will be provided by CIAT through your local office of Pan-American World Airways, excepting in those cases where Pan-Am does not have an office. In which case, CIAT will advise you directly where to obtain the ticket. CIAT is authorizing the airline to issue your ticket up to the value of the most direct route. At your discretion and expense, you may extend your trip or travel a different route. You will find, in most cases, that within the value of the authorization you will have several routing options. Should you have any difficulty with respect to your ticketing, please cable immediately.

PER DIEM: Upon your arrival in Cali, you will receive a check in US dollars to cover your travel and living expenses. This check will be for $125 US ($25 x 5). We will have assistants available to help you exchange this for Colombian pesos (current value, 20.70 to the US dollar).

At the close of the Conference, the following procedure is to be followed if you wish to convert the balance of your per diem to US dollars: a person who converts a dollar check to pesos should retain his receipt and upon presentation of this receipt, along with any unspent pesos, to an official money exchanger will receive US dollars in return.
Before converting pesos, all persons are reminded to save sufficiente funds for transportation to the Airport (30-40), plus 100 pesos for the international exit tax, and an additional 10 pesos for each Colombia Airport from which he may wish to depart on domestic flights. The exit taxes are not included on the international airline tickets.

HOTEL EXPENSES: We are making single room reservations for you at the Hotel Intercontinental Cali, with the special rate being 225 pesos single, 285 pesos double, regardless of the type of room assigned. If you wish to share a room with another participant, you may make such arrangement upon arrival.

CLOTHING: Cali is at 4 degrees N., but the elevation is 3,300 feet. The average mean temperature is 75 degrees. The hotel guest and conference rooms are air-conditioned, and most people find a light-weight suit comfortable in the evening. Several of the local restaurants insist on a coat and tie in the evening.

VISIT TO TRINIDAD: Through Dr. Barry Nestel, IDRC of Canada, the University of the West Indies in Trinidad has extended an invitation to all interested participants to inspect the research in tropical root crops there. If you are interested in this opportunity you may wish to include Trinidad in your itinerary (following the Conference). Dr. P.H. Haynes, Department of Crop Science, or Dr. L.A. Wilson, Department of Biological Sciences, University of the West Indies, St. Augustine, Trinidad, West Indies, would appreciate receiving a note from you if you expect to visit the University.

VISITS IN COLOMBIA: If you are interested in visiting research stations, universities or other organizations in Colombia before or after the Conference, please let us know and we shall make preliminary arrangements. For your information, we have several times a day jet aircraft flights between Cali and Bogota and Medellín, and through these cities onward to Cartagena, Monteria, and Barranquilla.

WORKERS IN CASSAVA RESEARCH: During the Conference, we hope to bring up-to-date the list of persons doing Cassava Research, as originally prepared by Dr. Franklin Martin. Please bring with you a list of the names, titles, and addresses of any persons doing cassava research whom you believe may not be known to the participants. We would also appreciate your assistance in helping compile a list of current research in cassava.

REGISTRATION CARD: Please complete and return the enclosed registration card, at your earliest convenience. If we know the date of your arrival, flight number and arrival time, we shall have a CIAT representative at the Airport (Palmaseca) to assist with customs, baggage, and transportation.

ext. 2342 12/20/71

Dear Chuck:

I've reworked and slightly modified some of your comments, thinking that it should be given just a bit more slant toward cassava specifically, but hopefully without wrecking the ideas in your first slice.

If you can get Gil to put his flow-charting capacities to work on these words, he probably can get us further down the road on the illustration alluded to at the end of the paper. In this connection, I'm also getting my former student Appan to work on some details of a systems approach to genetic improvement. Hopefully, he will have time to work up something to supplement our writings at the Cali meeting next month.

Enjoyed having you with us last week.

Merry Christmas,

Since sending in my original comments to Dr. Alvarez-Luna, it has been brought to my attention that some of the recommendations I made are not sufficiently understandable, and those particularly in the realm of systems analysis are the least understood. It may seem that I am trying to introduce an entirely new discipline to study the problems of cassava, and to substitute a new discipline for those which most of us know to be important. Let me try to dispell this misconception by saying that my intent in the use of systems analysis is not to supplant, but to aid the disciplines which are immediately important.

But why bother with such an approach? I think a little history will aid in the explanation, and I trust you will bear with me for making it a somewhat personal history. 20 years ago, when I first became interested in cassava, very few temperate zone people ever heard of the crop, and it was very difficult to get assistance to make studies of any sort, and particularly so if one wanted to do a basic botanical study. The interest in studies of the crop have very gradually increased, as more and more of the influential people in positions of decision became sufficiently knowledgeable about the crops that actually supported the people of tropical areas.

To be sure, there have been a small number of scientists who examined some aspect or problem with cassava, but by comparison with such crops as wheat, rice, maize, or potatoes, there has been no sustained effort by any number of workers to build up our knowledge of cassava. I have compared our knowledge of cassava today with that which was known about any of the crops mentioned above, and find that we are about 100 years behind the other major crops. Through the influence of a small number of far-sighted people, we are now about to embark upon research and development to catch up. I will not single out these influences, for those of you here know them as well as I.

Since we are now embarking upon a great adventure, it is my humble opinion that we should take advantage of all the new tools that are available to us today to be certain (or as certain as we can) that we do not stumble, but rather, order the priorities in such a way that we come to solutions of the problems of cassava most directly, expeditiously and economically. We want each scientist's results to become a contribution to development as soon as they are available, rather than being obscured and not recognized for their value until some later time. We want to prevent duplication of effort, by coordination and cooperation, and to this end, I recommend to you the methods of systems analysis to achieve these worthy goals.

A DESCRIPTION OF (OR AN EXPLANATION OF) THE SYSTEMS APPROACH FOR CASSAVA
(OR ANY OTHER COMMODITY)

The systems approach to development is guided by three major endeavors or stages: (1) mapping, or charting, of the present role

(2) establishment of norms or goals of improvement

(3) optimizing of procedures to meet the goals of (2).

Our objective is to get the best set of directives for research and development of cassava, and to begin with, we ask the question "what is happening now?"

To answer this question, we employ endeavor number (1), mapping, starting with "the consumer", and discovering the nutritional and consumption attributes, then the channels that bring the product to consumption or conversion. (Conversion being the various types of processing which make some product different from the raw product.) Then we map the means of production/in detail, and finally, describe (the various agricultural procedures) (labor, seed, fertilizers, harvesting, etc.) the necessary inputs to production. This mapping may be quite complex, inasmuch as it should be a combination of different specific places and times. That is, for example, Nigerian requirements are different from Tanzanian, from Brazilian northeast, from Cauca Valley, Colombia, etc.

After we have discovered the present roles, and problems of cassava, we then proceed to the second stage, establishing norms or goals for R & D. The goals will be improvement of present systems of production and/or consumption. In some cases this would involve greater productivity from the crop, in others modification of the products, or might, in still others, ignore the crop in the hope that use of the food will decline in favor of alternate, but more useful diet items. Again, the goals are place and time specific.

Third, optimization procedures would be applied. This is the technical heart of the systems approach. Having established goals and priorities for development, we use techniques for improving the chances of achieving them in the most economic fashion. One set of goals will most likely involve genetic modification of the crop in some direction, such as disease resistance in West Africa. We use information retrieval systems to discover those attributes of the crop most likely to be useful in developing the disease resistance. We employ correlative and clustering techniques to find how these attributes are related in various varieties, and where these are found (geographically). We employ then the classification system of the cultivars to discover if these attributes are already present

or whether breeding work has to be done. If breeding work is required, the same set of programs provides the descriptive information necessary to bring about the goals desired. At each stage we check back against the mapping and the goals to determine whether we are converging on a solution to the problems most expeditiously.

Since the modifications of the above stage will eventually cause some effects on the consumer, we use other packages of programs referred to as a general systems simulation model that can be employed to assess the consequences of complex interrelated changes in demand, distribution or production parameters.

These procedures are employed to facilitate communication within an interdisciplinary team and between that team and policy makers who may control the allocation of resources needed to modify cassava (or any major food commodity) as it relates to agricultural exploitation.

We present below an illustration of the techniques described above, but before doing so, it may help the reader to be acquainted with the experiences of the authors as they related to the evolution of these ideas and this proposal to employ these systems.

Brief history of prior work

Syst mod

Genetic opt Cult Tech Factor Inputs
land labor

Assembly techniques

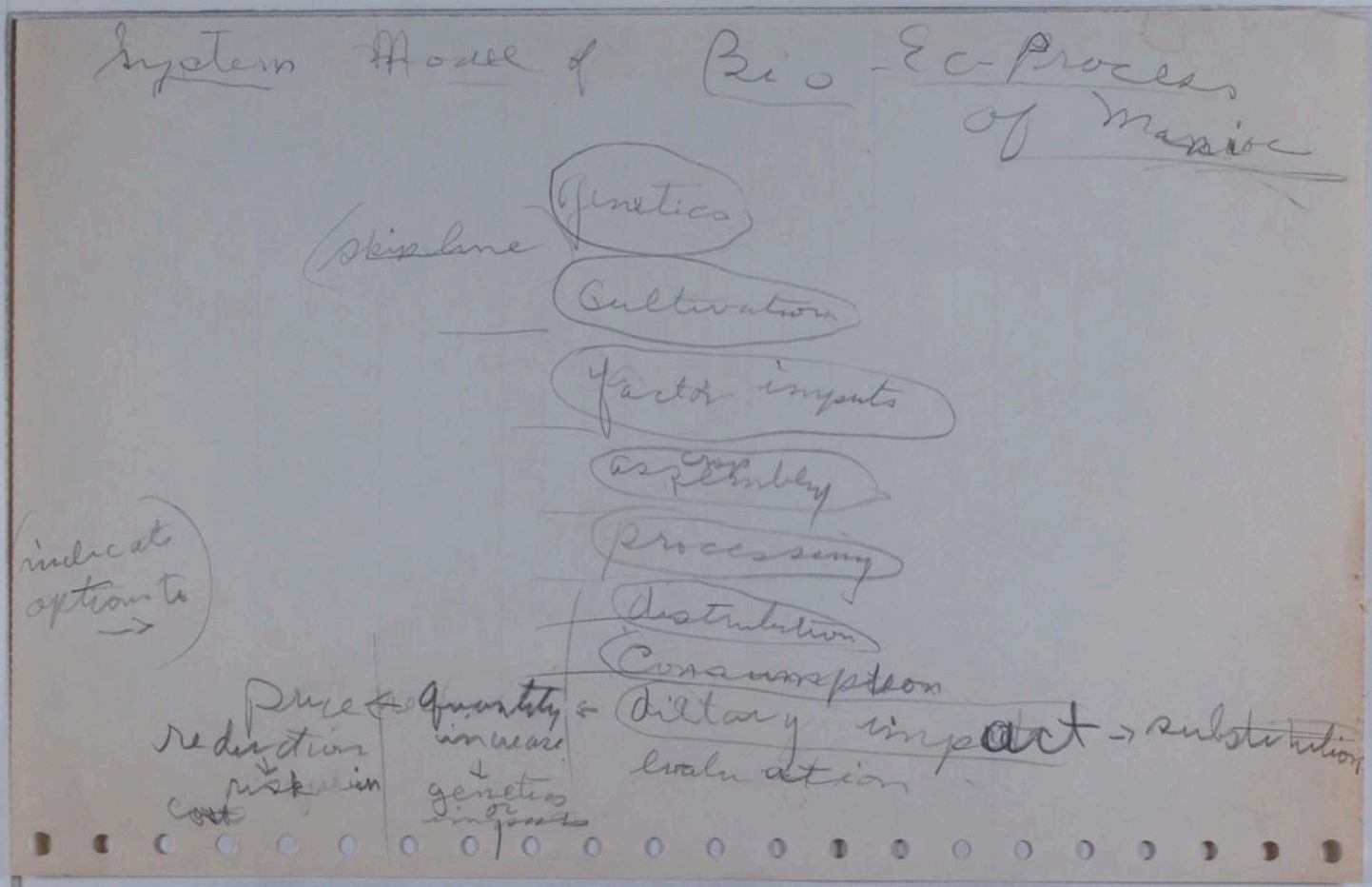
Changes in processing

" in distrib.

" in consumption.

Evaluate dietary intake

Decision
↓
Increase,
Modify-
Reduce ↔ rise in cost → Expand agricultural channels
Substitute – educate.



What is Systems Approach:

NUTRITIONAL ~~REQUIREMENTS~~ ⇒

goals or norms descriptive attributes

URBAN
Diet ✓
Population

RURAL
Diet
Population

INDUSTRIAL
Food Production

↓

~~Channel Requirements~~

Urban Retailers
Wholesale Structure
Transport & Assembly

} Rural Markets

} Industrial assembly mkts

Production ~~Requirements~~

Input ~~Requirement~~

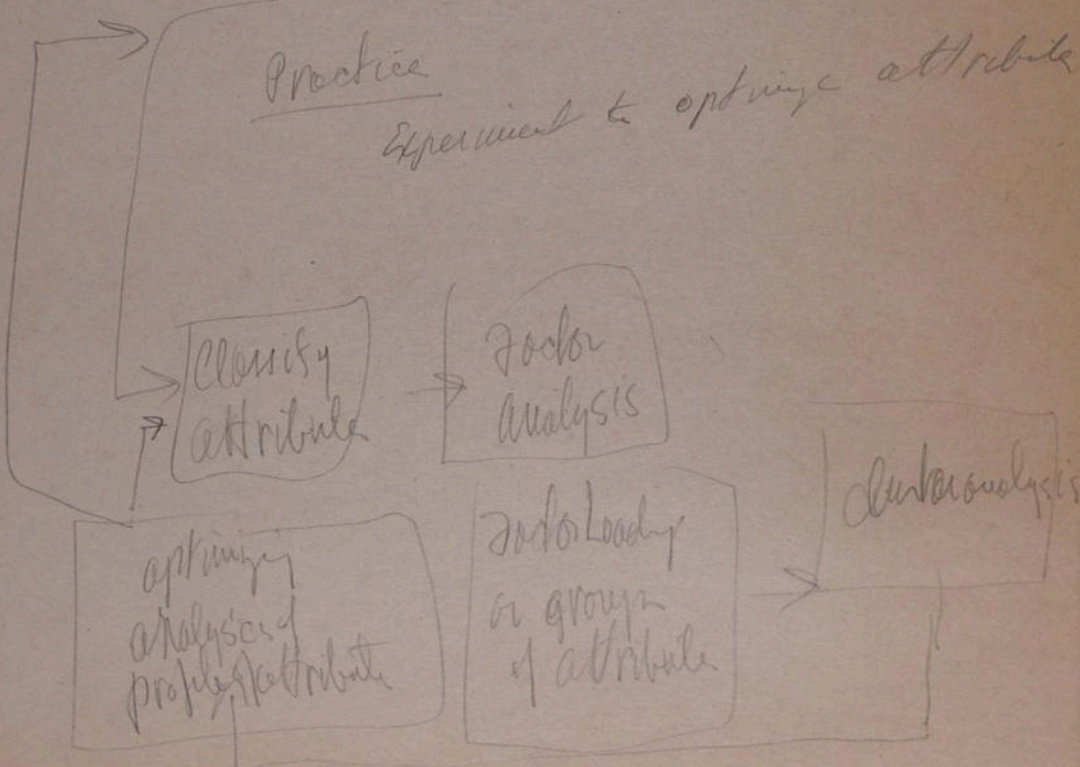
Research Requirements

Requirements

① Map the requirement from market back to input & back of Production

② Attribute
Genetic Rich. – optimize attribute

Practice
Experiment to optimize attribute



Diet Mix

Maize	Other foods	C_M + P_M	C_O + P_O
.10	.90	15/16	1
.50	.50	80/70	
.80	.20	.70/50	

I Map

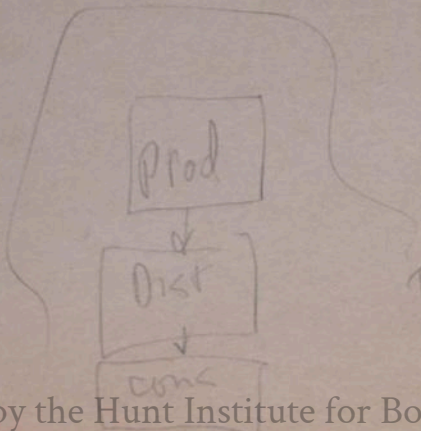
II Norms

III optimize

A. Model of Genetic + Biological attributes

Identify by Mental Attributes

- Class
- FA
- CA
- Opt



B. Prod/mkt system

AN INTEGRATED SYSTEMS APPROACH TO CASSAVA (or other food commodities)

In order to first understand the attributes of manioc as a commodity and then cope with the dietary impàications of thès important food, an integrated systems apporach to the problem is recommended. What is meant by this term is the subject of this memerandum.

Three interrelated steps are invààved:

First, a mapping of the product back from the nutritional and consumption attributes through the channels that bring the product to consumption of conver~~s~~sion ; then production needs to be described in detail, finally, inputs should be described. This description should be place specific to deal with one particular food shed and growing area.

Second, an identification of norms or goals of improvement of the cassava production-consumption system. In some cases this would involve increasing the nutrient available, in other cases ignoring the cultivar in the hope that use of the food will decline in favor of alternate, but more useful diet items. Again in each case the norm would be place and tim e specific.

Third, optimization procedures would be applied . This is the technical heart of the systems approach. Two models are su gested as interrelated techniques for improving the chances of achieving the norms indicated above.

The first of these systems models involves a set of programs for describing, classifying , factor analyzing and cluster analyzing the attributes to facilitate selection fo theproflie of attributes desired. The second program package is a general systems simulation model that can be employed to assess the consequences of complex interrelated changes in demand, distribution or prodction parameters.

The three step procedure outlined above is essentially an heuristic process to facilitate communication within an interdisciplinary team and between that team and policy makers who may control tha allocation of resources needed to modify cassava (or any major food commodity) as it relates to agricultural exploitation.

In this preliminary memorandum it might be useful to illustrate more fully the application potential of the techniques described above. But first, it may help the reader to be aquainted with the prior experiences of the authors as it related to the evolution of these ideas and the proposal offered here.

(insert brief histroy of prior work etc...)

The mapping exercise would no doubt involve descriptions of nutritional levels as well as norms for urban and rurla consumers of various age and income levels, etc. Perhaps industrial uses or animal animal feed uses should be indentified in some cases. This mapping shoudl identify th purchase behavior of households , preparation practices, and consumption of other foods by various members of the families studied. In this way the strategic needs of the community and related food shed can be identified. The channel mapping should measure quantities and prices of various forms of the product as it reaches final consumers. Rural and urban channels as weal as should be mapped. The production techniques and the inputs both those presently utilizaed asswell as the potentially applicable inputs should be identified.

With such a map in mind, the morphological and other attributes of the plant and its growing and processing technology can be the subject of the classification analysis. When varietal differences are assessed for the 107 varieties against these desired attributes, the process of selection and actual plant breeding may be cut short. The specific procedures to be employed here would be to assess the attributes of the varieties, (using the taxometric classification program) then group the

factors by the factoranalyetic routine before conducting a cluster analysis. With the cluster analysis results a profile of the desired attributes will be matched to the most probably genetic attributes of the varieties of the cultivar.

A second systems approach complements the taxometric analysis system. This is the general systems simulation model developed to evaluate some of the consequences of food marketing refomrs in developing communities. The application here would involve treating cassava as two products (the traditional and a modified commodity) All other food and non-food consumption goods would be grouped in a third catagory. The income, employment and nutritonal consequences of variousmodifications of product, channel and conumption behavior would be assessed. The menit of such a simulation model is in explaining the cost-benefit consequences of alternate production, processing, distributive, or consumption strategies.

While this memo is indeed cryptic, it is hoped that it conveys some ofthe logic of <u>one</u> potentially applicable sy tems approach to the complex problem of this intreguing commodity - cassava.

C I A T C a s s a v a P r o g r a m R e v i e w C o n f e r e n c e

Notes by David J. Rogers, Prof. of Biology, Univ. of Colorado, and Visiting Scholar, Food Research Institute, Stanford University

Introductory Comment

Because most of my endeavors relate to the third item in Dr. Alvarez-Luna's request for a memorandum for this conference, I shall pass over the first two requested items and devote this memorandum to his third item, entitled "The status of cassava research in his institution or area, and his ability or interest with respect to cooperation in the proposed program." I am certain that others more qualified than I can address themselves to the first two items in a much more detailed manner.

Although not a part of the conference agenda, I trust that there will be an opportunity to discuss problems of education. I append a few paragraphs with my suggestions along these lines.

Research endeavors, results, and areas of cooperation

A. Major research areas. Over the last 19 years I have devoted my research efforts with cassava to three major endeavors. These are: (1) basic botanical research (classification), (2) computer systems development, and (3) integrated research systems (or systems analytic approaches). In addition, I am at the moment in the process of writing a general book on cassava, in the style of the World Crop Series of texts.

B. Basic botanical research. In this area, I have had the objective of discovering the parameters of variation within the cultivated Manihot esculenta complex, and to imbed the cultivars within a classification scheme of general applicability no matter in what geographic area the variations are found. As a necessary correlary to this objective, it was necessary to make a classification of all the species of the genus Manihot to show the relation of the cultigen to its wild congeners. I felt that such a basic study was needed as a prerequisite to future work in plant-breeding, and other important agricultural efforts. My classification provides information on the kinds of variation that occurs in the tropics of the Western Hemisphere, where these variations occur, and how the variations are related within the complex. I have sampled the variation in most of the growing areas within the Western Hemisphere, from the West Indies, Mexico and Central America, and South America. Five hundred population samples representing variation in many habitats and countries have been collected, and these formed the basis for making the classification. Representatives of these samples are maintained as herbarium specimens which are now deposited in the herbarium of the National Arboretum, Washington, D.C., and may be consulted by any worker who wishes to use them.

Since much of the variation within the cultivated species is apparently caused by hybridization with various wild species, I also felt that it was important to show the relations of the cultivated species to the numerous wild species in the genus Manihot. To accomplish this classification, I collected samples of wild species in many of the areas where they are found as natives. In addition to my own samples, I studied 4,500 herbarium collections from most of the world's important herbaria. Previous classifications of the genus were completely inadequate, and much confusion occurred because the precise limits of the species had not been established. Classification of both the cultivars within the species M. esculenta and of the species in the genus Manihot was accomplished using computerized systems.

As a result of these endeavors, I have completed the classification of the cultivars of M. esculenta, and the manuscript is in the hands of the editor of the journal ECONOMIC BOTANY. The manuscript for the species of the genus is in its final writing stage, and will soon be submitted for publication.

The classification work is important in that it provides documentation for the types of variation that exists in the cultigen and its wild relatives. The documentation does not claim completeness--that can only be achieved by continued effort, and I see this continuation as one of the areas for cooperation. If we have continued work on classificatory documentation, we can be more assured that the work of individuals in various areas can be correlated with the results of others. This should prove important in plant breeding and other improvement procedures. Furthermore, with the knowledge at hand, I can aid by recommending certain types of cultivars and wild species to be used in breeding programs, and by more efficiently collecting propagating material. The documenting system also makes the work of gene banks more efficient.

C. Computer systems development. I shall not give a lengthy description of this work, but describe only the major aspects of it. I undertook the development of programs for computers tailored for studies of cassava in order to be able to deal with the very large data banks necessary to study the crop in an efficient and objective manner. The three major computer programs give cassava workers an opportunity to correlate their data, determine inter-relationships between hybrids or other groups, and to store and retrieve information rapidly. These programs, of course, require large scale computing facilities, but by appropriate scheduling, users can be given service from nearly any point where workers are. The computer programs are very powerful allies to the work mentioned above, and I should be glad to offer these services in aiding the development of cassava research.

D. Integrated research systems. Over the past few years, scientists have found that their own work is integrated into developments more rapidly if they work as members of interdisciplinary teams, where the problems of development dictate the actual direction of the research to be accomplished. For example, the work of nutritionists is much more

meaningful in producing balanced diets if these scientists work in conjunction with economists, plant or animal breeders, anthropologists, social and medical scientists. The aim of producing adequate diets in countries with high carbohydrate and low protein food resources are best accomplished when the nutritionist is aware of the potentials in the marketplace and the potentials from various native resources of usual and unusual food substances. The plant breeder can gain better perceptions of his breeding objectives in the same manner. I recently worked in the Congo with nutritional biochemists, market research specialists, and biologists, in the development of a system to provide high protein supplements for children in an area with a largely cassava-based diet. In this milieu, it was discovered that the objectives of plant breeding should be focussed on disease resistance of cassava cultivars (particularly to mosaic viruses), and that no attempt be made to breed higher-yielding protein in the roots of cassava because the protein requirements could best be met by combining other local resources, such as leguminous crops, the foliage of cassava, dried fish, and even dried caterpillars (a local delicacy). Cassava itself could be a better source of proteinaceous material if there were more development of post-harvest fermentative processing techniques, a process requiring the skills of microbiologists, food technologists, and students of systems analysis. Each discipline gains better insight into its own research priorities when each is integrated through the efforts of the systems analyst. Of course, the basis of all such endeavors requires that information exchange is accurate and rapid. Since we must realistically anticipate that cassava workers will not all be assembled in one research and development facility, the need for information exchange becomes more imperative. We have made an informal design for an information exchange system amongst cassava (and other root crop) workers, but have gone no further with implementation. Hopefully, we can aid in the development of such an exchange system.

Summary

We now have a basic botanical classification structure for the improvement of the plants in the cassava gene pool. We know something about the relationships within the species complex and between the cultigen and its wild relatives. Actually, this is a bare-bones system which needs much more work to make our classification system more accurate. There are many data that should be correlated but which we cannot until there is a decision that the work is sufficiently important to be continued. We know very little about other basic botanical information, such as the cytogenetic variability within M. esculenta and the wild species. We know very little about the physiology of the plant, including starch production. Realistic work on the important poisonous properties has just recently been started. If we are to make forward strides in cassava development, we must carry on some basic botanical research along with the more practical agricultural work. We must integrate our knowledge, and greatly improve our means of data and literature exchange, so that workers anywhere in the world may be kept abreat of the results of their fellow workers.

Appendix
Suggestions on Education for Cassava Workers

I do not intend the following to be a diversion from the main theme of this conference. I merely add it because of my own strong feelings in this area.

With respect to education and/or training of students of cassava, I think that we need to give individuals in various agricultural centers a review of what is known about cassava presently, so that these individuals have a base from which to continue their own work, whatever their own needs. I think we need to encourage at least a few students to become oriented to cassava work for their advanced degrees, and in various disciplines. There is no need for me to emphasize to this group the importance of the several agricultural disciplines, so my emphasis is on an area close to my own, botanical. We tend to forget that there have been many important developmental aspects which grew out of basic botanical research with most of the major crops. We know that there are relatively few students who have done good botanical research on cassava. I do not wish to offend those few who have made such studies, but we need much more thorough anatomical, cytogenetic, physiological and ecological studies. We definitely need to refine the classification of the species. Much of this work can be supplied by advanced degree students, who will concentrate on cassava for their thesis research.

At the same time, such students should be made aware of the various other types of investigations through interdisciplinary educational programs. It is as important to the botanist as to any other scientist that he be aware of the economics of cassava, and of the anthropological and ethnological work that has been done and needs yet to be done on cassava.

To accomplish the above suggested goals, two types of programs can be recommended. Training programs of short duration--two or three weeks, for those who already have received degrees, carried out under the auspices of CIAT (and perhaps IITA), where experts could review the cassava literature in certain disciplines, and provide a reading list for those attending the training sessions.

The second type of educational program would be of longer duration, and students would matriculate in various universities where the educational program is already directed towards various important botanical and agricultural studies. The student would work on thesis research specifically related to cassava for his advanced degree. There are a number of universities in the world where such work could be done. Perhaps the field work for thesis research could be done from bases at Cali or Ibadan, whichever is more appropriate for the particular student.

These are only suggestions, but I trust that the conference participants will have some thought s along these lines.

DJR

December 10, 1971

Dr. Eduardo Alvarez-Luna
Director, Plant Sciences
Centro Internacional de Agricultura Tropical
Apartado Aereo 67-13
Cali, Colombia, S.A.

Dear Dr. Alvarez-Luna:

Please forgive my tardiness in preparing the memorandum requested in your letter of September 13. I have given the matter considerable thought and you will find that my remarks go somewhat beyond the topics listed in the statement of background and procedures. But let me deal with these first:

1. I have, for more than 20 years, been interested in the economics of manioc production, consumption, and distribution around the world, sometimes intensively, at other times only keeping up with new developments. I know most about manioc in Africa, and the book I published on this subject in 1959 is still a fairly accurate statement of "the status of cassava production and utilization" there.

2. It is difficult for me to reply to the second question. I should feel much better if this question were framed in terms of the future role of the crop, as it is in the tentative agenda that I received today. (I shall be happy to serve as discussion leader for that session as you request.) Briefly, I feel that manioc has an important role to play in production and consumption if it continues to be possible to capitalize on the major advantages of the crop. In the memorandum appended to this letter I have elaborated on this statement.

3. I should be very much interested in cooperating in the proposed program. The extent of this cooperation and the extent of participation by the Food Research Institute must depend on the direction that the program takes and the resources that can be made available to cooperating institutions. For your information I enclose a brochure that describes the character of the Food Research Institute.

Sincerely yours,

William O. Jones
Director

WOJ:hh

Jones 12/10/71

SOME VIEWS OF A PROGRAM
OF RESEARCH ON MANIHOT ESCULENTA

Research and development directed at manioc should attempt to capitalize on the characteristics of the crop that give it a peculiar comparative advantage in tropical agriculture. These I take to be the following:

1. High potential yield of food calories per hectare, especially where the plant can occupy the land for 14 to 16 months.
2. Economic yields under relatively poor soil conditions and erratic rainfall regions.
3. Possibility under appropriate farming conditions that most plant nutrients taken up by the growing plant can be returned to the soil.
4. Possibility of low planting and cultivating costs relative to harvesting costs (especially if the plant quickly establishes a good canopy.
5. Relatively low time specificity of harvest.
6. High resistance to pests and disease (with leaf mosaic a notable exception).
7. Vegetative propagation that insures presertation of desired characteristics.

This suggests the following elements in a development program:

1. Strive for high yields without fertilizers, irrigation, or pesticides (This seems to imply broad spectrum resistance, minimum of inbreeding.)
2. Strive for greater understanding of the physiology and ecology of the root system.
3. Explore farming systems that will permit the return of a maximum of nutrients to the soil.
4. Design plants that can be harvested at lower costs (e.g., modify root form and position), reduce height of tops.
5. Seek early establishment of closed canopy.
6. Seek shorter time to economic yield (e.g., 6-8 months).

Aspects of the crop that are not completely understood and that may be or have been shown to be important are:

1. Mosaic disease.
2. Amount of HCN in the products used for food or feed.

It seems obvious that mosaic needs attention, at least in tropical Africa, although the extent to which mosaic reduces yields is not definitely known. More needs to be learned about the possible effects of continued ingestion of small amounts of HCN, both directly and through possible reduction in the availability of sulphur-bearing amino-acids. Considerably more information is needed about the nutritional characteristics of the products and about characteristics that are attractive to consumers.

The present character of farming in most parts of the world where manioc is important requires a crop that fits easily into labor intensive, small-scale operations. The day will come, however, when opportunities will arise for substitution of animal or mechanical power for labor in the cultivation of manioc. This will make the form of the plant increasingly important.

William O. Jones
Food Research Institute
Stanford University

September 24, 1971

Dr. Eduardo Alvarez-Luna
Director, Plant Sciences
Centro Internacional de Agricultura Tropical
Apartado Aereo 67-13
Cali, Colombia

Dear Dr. Alvarez-Luna:

Your kind invitation of September 13 was forwarded to me at the above address, where I am spending a sabbatical leave, as a visiting scholar.

I am pleased to accept your invitation for this very important Cassava Program Review Conference, and will send the requested memorandum in good time.

No doubt you will be hearing shortly from Dr. Jones, whom you also invited to participate.

May I recommend that you invite Dr. S. G. Appan to the Conference? Dr. Appan completed his PhD under my direction in 1969, and stayed on for a post-doctoral program with me for one more year. He is one of the few students I know who was specifically interested in, and concentrated his thesis on problems in cassava. He had considerable experience with cassava at Trivandrum, in the Indian Government's Root Crop Experiment Station, before coming to study with me. I think he will contribute a great deal to the Conference. His address at the moment is:

Gulf Universities Research Corporation
Building 1100--Room B313
Mississippi Test Facility
Bay St. Louis, Mississippi 39520,
USA

Thank you for your consideration.

Sincerely yours,

David J. Rogers
Visiting Scholar

recommend
C.H. de Bruijn as possible participant Oct. 14

C I A T

APARTADO AEREO 67-13
APARTADO NAL. 737
CALI - COLOMBIA
CABLES: CINATROP

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL 270-DCAG.

September 13, 1971

Dr. David J. Rogers
Department of Biology
University of Colorado
Armory 101
Boulder, Colorado 80302
U. S. A.

Dear Dr. Rogers:

On behalf of the International Development Research Centre and the "Centro Internacional de Agricultura Tropical", it is my pleasure to invite you to participate in the Cassava Program Review Conference described in the attached. We hope you will be able and willing to share your views and experience with some 20 other participants in helping develop plans for a comprehensive international research program in cassava.

Details of this important meeting are outlined in the attached, and we look forward to an early indication that you will be able to attend.

Sincerely yours,

Eduardo Alvarez-Luna
Director, Plant Sciences

EAL/bmh
Encl.

cc.: Dr. B. Nestel: IDRC
Dr. F. Byrnes: CIAT

Background and Procedures for the
CASSAVA PROGRAM REVIEW CONFERENCE
January 10-12, 1972

BACKGROUND: Plans are underway to expand the preliminary cassava (Manihot esculenta Crantz) research and development activities of the Centro Internacional de Agricultura Tropical (CIAT) into a more comprehensive program. This expansion is being made possible through the financial support of the Government of Canada, these finances being directed through the Canadian International Development Agency (CIDA) and the International Development Research Centre (IDRC).

PURPOSE: Before embarking on this broader program, CIAT and the Canadian interests have jointly decided to invite a representative group of scientists interested in cassava to review the present and projected cassava research program, to outline the optimum distribution of research emphasis, and to identify potential areas for cooperative effort.

DATE AND PLACE: The conference is scheduled for January 10, 11 and 12, 1972, at the Hotel Intercontinental Cali in Cali, Colombia. Participants are requested to plan their travel so as to arrive in Cali no later than the evening of January 9.

EXPENSES: Invited participants will be furnished economy class, jet, airline tickets, plus $25 per day for expenses, and $75 a day honorarium provided they are present for the full period of the conference. Upon acceptance of the invitation, CIAT will arrange for the ticketing through Pan American Airways.

REQUESTED PAPERS: While formal papers will not be presented at this conference, CIAT requests each participant to prepare a two or three page memorandum which will be circulated to all participants to stimulate and facilitate discussion. In this paper, each participant is asked to express his views on the following points:

1. The status of cassava production and utilization in the areas with which he is familiar.
2. The principal factors limiting cassava production and utilization in these areas, and the related research needs.
3. The status of cassava research in his institution or area, and his ability or interest with respect to cooperation in the proposed program.

Please mail these papers so as to reach CIAT by December 10, 1971.

NOTE: Invited participants who know of someone whose contributions would be valuable are requested to send CIAT his name and address at their earliest convenience. When it is not possible for an invited person to accept, the organizers of the conference would appreciate receiving the name of a possible substitute for consideration, along with pertinent biographical data.

November 24, 1971

Dr. Eduardo Alvarez Luna
Director, Plant Sciences
Centro Internacional de Agricultura Tropical
Apartado Aereo 67-13
Cali, Colombia

Dear Dr. Alvarez:

Enclosed please find my memorandum for the forthcoming cassava conference. I send it now because, as you can see, I have taken some liberty with your request for information in the memorandum. If you find the enclosed unsatisfactory, please let me know, and I shall be glad to rework it.

You will note that I also took the liberty of appending my ideas on education, which was definitely not a part of your request. If you find that this takes away from the conference, please feel free to remove it from my memorandum. I have placed that page at the end so that it will not be difficult to excise.

I also write now to ask for your approval to spend an extra three days in Colombia, after the conference concludes. There are two species along the north coast which I would very much like to collect. One of these, M. carthaginensis, was first collected and described from Cartagena, and I would very excited to get both propagating material and other material for analysis. The other species, M. brachyloba, is found near the coast east from Baranquilla. I would be glad to collect and send propagating material back to Cali, if you are interested. I have an informal arrangement for the growth of wild species with the Fairchild Tropical Garden in Miami, and want to have these two species in that collection, as well.

Please let me know if it is feasible to make these arrangements, an also whether the content of my memorandum is acceptable. I look forward to hearing from you.

Sincerely yours,

David J. Rogers
Visiting Scholar

Encl.

INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE

OYO ROAD, P.M.B. 5320, IBADAN, NIGERIA

Cables: TROPFOUND, IKEJA

Telephones:
Administration: Ibadan 23741
Communications Centre) 23570
Bodija Estate) 24639

Lagos Office
89, SOBO AROBIODU AVE.
P.O. BOX 145 IKEJA
Telephone: Lagos 33931

6th November, 1971

Dr. David J. Rogers
(Visiting Scholar)
Food Research Institute
Stanford University
Stanford, California 94305
U.S.A.

Dear Dr. Rogers,

Thank you very much for your kind reply dated October 27, 1971, indicating that you are interested in cooperating in our root and tuber improvement program and giving us your invaluable suggestions.

I am also planning to attend "Cassava Program Review Conference" which will be held at CIAT, Columbia in January 10-12, 1972. I wish I could discuss in more detail with you on some problems related to our works while attending the conference.

With regard to cassava seed introduction plan, in our early improvement program, we are going to build up our genetic variability of cassava by seeds, since we have so much difficulty in introducing vegetative materials because of the present Nigerian quarantine regulation. Out of the seedlings, we do hope we could obtain some of the selections with some desirable characters or genes, which might be utilized for breeding. In the long run improvement program, we should, of course, introduce and utilize the already known and available cultivars for our breeding work. However, we expect it will take about a year or more to get the actual cultivars through Nigeria quarantine office, in view of the present situation.

With Nigeria government, IITA is trying to find an improved introduction system.

Your suggestion on the establishment of a quarantine and increase garden in some locality outside the normal production areas of cassava, would be a solution, if the system were arranged.

Looking forward to meeting you at CIAT, Colombia, in January, 1972.

Sincerely,

Sang K. Hahn
Plant Breeder (Root and Tuber Crops)

/jio

October 27, 1971

Dr. S. K. Hahn
International Institute of Tropical Agriculture
Oyo Road, P.M.B. 5320
Ibadan, Nigeria

Dear Dr. Hahn:

Thank you for your letter of October 8, with respect to germ plasm resources for breeding work in cassava and other root crops. I am interested to cooperate with you and hope that we can get some work started.

However, there are several aspects which I believe have to be discussed before any dispath of propagating materials. Before any further exchange of plants, particularly any vegetative material, we must set up some means by which we can protect recipient countries from the introduction of any external pathogens. It will be necessary, therefore, to have some informal, binding agreements between countries interested in improvement of these crops. You certainly know that CIAT in Colombia is also interested in cassava work, and I believe that there can be some way for your organization in Ibadan to work out agreements which will help to prevent spread of unwanted diseases. I will be attending a conference at CIAT in January, and at that conference, I expect to urge that some agreement be reached before continued import-export of plants except through some intermediate quarantine.

Another problem that I am not certain about from your letter is what sort of seed you expect to use in cassava breeding work. If you are speaking about seed from various cultivars of M. esculenta, I am surprised, because you have no certainty that the seed you plant has the genetic complement of the parent plant. Efforts to produce pure lines of seed have (so far) failed, and I personally think that the effort to develop inbred lines in this crop are an unnecessary and time-wasting procedure. Seeds from wild species are not always available at the time of collection, and cuttings are about the only practical means of reproduction.

For the above reasons, I suggest that we attempt to establish a quarantine and increase garden in some locality outside the normal production areas of cassava, where all introductions can first be received, grown and tested and then trans-shipped to you. I believe that a cooperative arrangement can be made with the USDA at their Miami, Florida facility, but we still have to make this arrangement. I have not contacted any USDA authority, but will do so if we can work out some agreeable set of procedures.

A final problem that must be faced is the proper financing of the whole collecting and distributing operation. Are you in a position to give contracts or grants for such work? I do not have funds for collection, for travel, and for other associated expenses. Some arrangements must be made, but I think that these can be considered by Rockefeller-Ford, both for the IITA and CIAT installations. It would be wise to have the genetic materials growing in both localities, to insure that viable material is maintained on both continents. I think that, in terms of efficiency and success, I can probably get more useful material than most, simply because I have spent a number of years studying the various wild species, as well as the variants of cassava. I know precise localities for the wild species, which is a great aid in efficient collecting, and besides, have a great interest in getting more interesting genetic material into the cassava gene pool.

Again, I hope to take up these matters when I go to the planning conference in Cali, Colombia, this coming January. These are vital matters, and I trust that you will consider them with me, and hope that we can make some arrangements satisfactory to your needs.

Sincerely yours,

David J. Rogers
Visiting Scholar

Incidentally, I will be here at Stanford at least until February, 1972. Please use this address until that time.

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Dr. D.J. Rogers
Taxtmetrics Laboratory
University of Colorado
Boulder, Colorado 80302

8th October, 1971

Dear Dr. Rogers,

I am now in a position to develop close cooperative work with you on tropical root and tuber crops including cassava, yam, sweet potatoes, and cocoyams.

The major emphasis in our early root and tuber crop improvement program is placed on germplasm collection with special reference to resistance to cassava mosaic virus, improved plant types including both above ground parts and tuber which might be suitable to advanced techniques of cultivation, high food value, early maturity and improved keeping quality (in yam).

I would like to have any information and some materials related to these aims.

Since it is very difficult to assemble germplasm collections of these vegetatively propagated crops, introduction of materials in form of seed is an aim in our early collection program.

I look forward to close collaboration with your institute in our root and tuber crop improvement works.

Sincerely yours,

S.K. Hahn
Associate Scientist.

/jio