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FROM - RIO DE JANEIRO

SUBJECT - NONCAPITAL PROJECT PAPER (PROP)
Development of High Quality Protein in Corn

REFERENCE -

COUNTRY: BRAZIL PROJECT Nº: 512-15-130-247.3

SUBMISSION DATE: December 1969

PROJECT TITLE: Development of High Quality Protein in Corn

U.S. OBLIGATION SPAN: FY 66 through FY 71

PHYSICAL IMPLEMENTATION SPAN: FY 67 through FY 72

GROSS LIFE OF PROJECT FINANCIAL REQUIREMENTS:

U.S. Dollars	$459,000
Cooperating Country Cash Contribution (TF)	86,000
(CONTAP)	37,000
TOTAL	$582,000

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PAGE 1 OF PAGES 8

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JHulehan/RDesrosiers	PRPC/ARDO	419	12/23/69	ADPR: HHarrison

AID AND OTHER CLEARANCES
ARDO: WRodgers
PRPC: MFox
CONT: GNewton

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I. SUMMARY

The long-term objective of this project is to improve the general nutritional intake of the Brazilian people, both directly through the consumption of improved corn varieties high in amino acid content and indirectly through the use of corn with high-quality protein in mixed feed ration for rapid and efficient production of hogs and poultry. The short-range objective of this project is to improve the protein quality of corn through a plant breeding program that will increase the nutritive value of Brazilian corn.

This project is carried out by the Federal University of Viçosa (UFV) in the State of Minas Gerais in cooperation with the Ministry of Agriculture and other agricultural organizations in Brazil.

The Federal University of Viçosa provides land, facilities and technicians to carry out this project and develops cooperative subprojects with the Ministry of Agriculture, State Secretariats of Agriculture, other agricultural universities and government entities and with private agencies for the production, testing and distribution of the new varieties of high-lysine corn.

USAID assistance is provided through a contract with the Purdue Research Foundation under which one corn breeding specialist is providing technical assistance to the project. In addition, limited amounts of equipment and participant training are being provided by USAID. USAID financial assistance will be provided through FY 71, although some participants studying in the U.S. probably will not return until FY 1972.

It is estimated that approximately 80% of Brazil's rural population and nearly 70% of her total population suffers from malnutrition. Protein is conspicuously lacking in the diet of many young Brazilian children, and this is the stage of life when protein deficiency causes its greatest damage. Research has shown that even should dietary conditions improve in later life, when children between the ages of one to five years do not eat foods of adequate protein content value for their needs, their mental and physical capacities are permanently impaired. In terms of achieving the goals of economic development, to say nothing of the humanitarian aspects, the effect of this massive malnutrition is staggering.

Dietary habits are notoriously difficult to change, especially in emerging nations where illiteracy is high and income low. The process is laboriously long and expensive, and the assurance of success can never be very great. Improvement of the nutritional value of the foods that any given population presently consumes is a far less expensive and much more extensive method of relieving malnutrition. In Brazil the staples are beans and rice but corn is rapidly becoming an important dietary item.

Corn is also a major ingredient in animal feed, particularly for hogs and poultry. As the quality of protein in common corn is low (it is deficient in certain essential protein building stones - the amino acids, lysine and tryptophane) scarce and costly protein supplements (soybean meal, cotton seed meal, fishmeal, etc.) must be added to achieve efficient animal production. These supplements increase the cost of growing hogs and chickens, and in turn automatically eliminate or reduce the amount of these foods from the tables of low income families.

In 1963 scientists at Purdue University discovered that corn lines containing genes known as Opaque-2 and Floury-2 were unusually high in several amino acids, especially lysine and tryptophane in which grain crops are characteristically deficient. This discovery was recognized as possessing great potential for the correction of malnutrition arising from protein deficiency. Feeding trials in the United States and other countries indicate that corn lines with high contents of these amino acids can supply an adequate protein diet for nonruminant animals without the use of supplements.

The genetic transfer of these genes to other lines of corn is relatively easy. The goal of this project is to incorporate one or the other of these genes in lines already adapted to local Brazilian conditions and to develop and improve these lines until they are high-yielding and possess other desirable qualities in addition to improved biological quality and quantity of protein.

In June 1966 a Project Agreement was signed initiating a joint GOB-USAID effort to systematically adapt this seed to Brazilian conditions. The USAID contracted with Purdue University to provide the needed technical assistance and in September 1967 a full-time corn breeder from Purdue arrived in Brazil to work on the project.

As a result of this project it is hoped to replace to a large extent the common and hybrid varieties of corn now grown by Brazilian farmers with this new high-lysine corn. The effect of this on the subsistence farmer who grows corn for consumption by his family would be to effect a striking improvement in their diet. To the hog farmer and poultryman it would mean the possibility of fattening their livestock with corn grown on the farm, without the need to purchase protein supplements or ready mixed feeds. Corn products made from high-protein corn and sold in the retail trade as human food can also be expected to have an important effect on the diet of the country.

This project is expected to make a substantial contribution to Brazilian agricultural technology as well as to the nutrition of the country at relatively low cost. The project has contributed to increased interest in plant breeding, seed production, and nutrition.

Selection of corn for high protein content is progressing satisfactorily with several thousand ears of corn already having been assayed. The development of inbred lines and composite populations containing the Opaque-2 and Floury-2 genes is advancing as well. It has been found possible to grow a generation of corn at the Ministry of Agriculture research station at Km 47 Rio during the off-season at Viçosa, thus speeding the work. Arrangements have been made for trials to be conducted in the Northeast states of Pernambuco and Ceará and Opaque-2 and Floury-2 material has been supplied to agricultural institutions in those areas.

There has been a rapid build up of corn breeding material at UFV with active exchange of corn plasm with other corn breeders both within Brazil and in other countries. Keen interest has been stimulated in the scientific community and among the commercial seed companies of Brazil and several of these are now developing their own lines of high lysine corn using material obtained independently as well as that received from UFV.

.o lines of investigation are under way: 1) the development of an improved high-protein protein and high-lysine synthetic variety, and 2) the development of high-protein and high-lysine hybrids. Both endeavors are progressing satisfactorily. The first cycle of selection has been completed involving the analysis for protein content of 1000 selections, of which the 347 best were planted for further study and the second cycle is under way. Two hundred of these were analyzed in the U.S. for lysine content. The Opaque-2 and Floury-2 genes have been fixed in corn varieties adapted to Brazil and adaptation trials in several parts of Brazil have been started. Yield trials to date indicate that the possibility of producing high-lysine varieties and hybrids, equal or superior in yield to the standard hybrids, is excellent.

Feeding trials on pigs and laboratory animals have been carried out by Brazilian scientists in cooperation with the project and all substantiate the results of previous trials conducted elsewhere regarding the excellent nutritive value of the corn.

An easy, rapid, and inexpensive colorimetric technique for lysine analysis is under development through the project. Although technical difficulties have arisen, these are being worked out and this method is expected eventually to replace the costly and relatively slow one now used and should greatly speed the screening of selections. A High Lysine Corn Symposium was held at Viçosa in August 1968 and was attended by about 150 persons. Great interest was displayed by scientists and commercial people from various parts of the country and numerous papers were presented.

The planned targets for the project are as follows:

Incorporate into adapted Brazilian corn hybrids and varieties the Opaque-2 and Floury-2 genes to improve protein quality.

2. Stimulate use of these improved corn stocks in corn breeding programs at institutions, both private and governmental, throughout Brazil.

3. Conduct necessary nutritional tests to determine feeding value of corn varieties for humans and animals.

4. Train two Brazilian scientists in corn genetics to the Ph.D. level in the U.S. and six to the M.S. level in Brazil and train other Brazilian technicians in corn genetics and biochemistry through short courses and on-the-job instruction so that work may continue after the project is terminated.

5. Strengthen the capability of the UFV for carrying out this type of research and training students in this field.

6. Foster cooperation between private industry, universities and government institutions based on a common interest in improved corn.

As a requisite for continued USAID contribution and participation, the following are considered to be the minimum levels of output or achievement:

1. Continued Brazilian interest and progress in the incorporation into adapted Brazilian corn hybrids and varieties of the Opaque-2 and Floury-2 genes.

2. Continued Brazilian efforts to stimulate use of these improved corn stocks in corn breeding programs at institutions, both private and governmental, throughout Brazil.

3. Carrying out necessary nutritional tests to determine the feeding value of corn varieties for humans and animals.

The commercial seed trade is deeply interested in the project and at least four substantial private companies are actively participating in the development of new lines of high-protein corn. It is expected that the commercial seed companies will carry the major portion of the effort of publicizing high-lysines corn and encouraging farmers to plant it. As improved planting material becomes ~~xxxx~~ available in larger quantities, the extension service is expected to ~~x~~ play an important role in publicizing the new corn.

A close relationship has been developed between the project and the ~~Xxx~~ Rockefeller Foundation's corn program in Colombia for the exchange of breeding material.

II. SETTING

Numerous reports are ~~xxxxxx~~ available in AID/W and USAID/Brazil on the Brazilian agricultural sector and the reader is referred to them for background information. The importance of agriculture to the Brazilian economy is well documented. It is easily the most important economic activity in Brazil, employing more than one half the total labor force. The agricultural sector analysis, now being completed by USAID/Brazil, will provide a detailed analysis of this sector including a discussion of the many problems and adverse conditions which the sector faces.

As mentioned in Section I above, malnutrition is widespread in Brazil. Much effort is needed now and will be needed in the forseeable future to improve the diet of the Brazilian people. The GOB is engaged in numerous programs to improve the nutrition of its people.

In the northeast the situation regarding food production and nutrition has always been critical and may even be deteriorating. In 1963, in the Zona da Mata, a nutrition survey showed average ~~calorie~~ consumption to be 1990 per day. A similar survey in the same area in 1965-66 showed 1299. ~~Xx~~ Unemployment in the northeast is estimated at around one million. The middle and poorer classes suffer the effects of these ~~deficies~~ as shown in the high infant mortality rates and the widespread incidence of deficiency diseases, tuberculosis and other endemic diseases. Children are weaned early because the mother must go to work, and the foods the child then receives are not sufficient nor of the right kind to sustain normal growth and development. Insufficient amounts of both calories and proteins are particularly significant.

But the situation is not limited to the northeast. Recently in the State of São Paulo, the most highly developed area of Brazil, ~~69~~ 60% of all 19-year old boys called up for military service were rejected, mainly for insufficient height and weight, indicating chronic malnutrition since early childhood. In Porto Alegre, capital of the state of Rio

Grande do Sul, a survey showed that only 5% of the population enjoyed a nutritional regime considered excellent and 25% had food intake considered as good. The other 70% of the population had either poor (58%) or extremely poor (12%) alimentation.

Almost all of the USAID's agricultural projects are in one way or another related to increasing the overall nutritional level of the Brazilian diet. Some of the more directly related activities are as follows:

In the northeast special attention is being given to improving fish production through technical assistance from the U.S. Department of the Interior's Bureau of Commercial Fisheries.

One of the main objectives of the agricultural education projects is to expand the capacity of Brazilian institutions to train the technicians required for more rapid development of Brazil's agricultural resources. This will enable Brazil to become relatively self-sufficient agriculturally.

The agriculture research project to which the USAID is providing assistance through the IRI Research Institute contract has as one of its main goals to increase agricultural production in Brazil by securing and making available research data relative to the most economical and efficient means of feeding and managing livestock and producing crops with high nutritive value for human consumption.

USAID/Brazil also assists such organizations as the Rural Extension Service (ABCAR), the National School Lunch Program (CNAE) and the adult literacy program (Cruzada ABC), all of which stress nutrition and health education in their activities. Through participant training in the fields of agriculture, community development, health and education, USAID has sent many present and future Brazilian leaders to the U.S. for training in increasing food production, improving food technology, research and participation in programs for the well-being of the people, especially in rural areas. It has also sponsored travel of highly qualified technicians to specialized meetings on such subjects as production of high-protein foods as well as participants from various fields of endeavor to conferences on combating malnutrition. Under another USAID project two nutritionists from São Paulo have already completed advanced nutrition training at Columbia University under USAID sponsorship and three more have recently started.

III. STRATEGY

The manner in which the project has been organized and carried out to date has been influenced by the following considerations:

1. Location

The fact that the discovery of the importance of the Opaque-2 and Floury-2 genes was made at Purdue University influenced the location of the project at the UFV. Purdue has had a close relationship with that institution since 1952 and had already sent high-lysine corn material to the UFV for testing before any contractual arrangement was made for this project.

2. Nature of the project

Varieties of plants which perform well in one environment will not necessarily do so in another. The normal expectancy is that varieties will have to be selected or especially bred for each new setting. This is true of corn, and it is not unusual to find varieties of corn especially selected for each mountain valley in a given region.

Hence, the problem of developing high-lysine corn for Brazil, a job of breeding for factors not previously considered, requires research involving several operations including the following:

a) Breeding to introduce the Opaque-2 and Floury-2 genes to local varieties. This may require 20 to 80 varieties, or more.

b) Biochemical analysis of the progeny to determine protein and amino acid content.

c) Selection and breeding to combine high protein and desirable amino acids spectrum with other qualities such as high yield and disease resistance.

d) Field trials at various locations utilizing the facilities of other universities and of the Ministry of Agriculture Research Department requiring maximum possible number of replications to assure significant differences.

sufficient number of trained personnel capable of carrying out a project of this sort is not available in Brazil. It was necessary, therefore, to bring in a U.S. specialist and to train Brazilian technicians to carry on the work.

Subsequent phases of the work involving inducement of the farmers to use the new material will be handled by the national extension service (ABCAR) and the commercial seed companies. These latter are cooperating closely with the project, are utilizing genetic material developed by the project, and are breeding their own new lines of high-lysine corn.

By the time the project terminates in 1972, it is expected that high-lysine corn of superior quality and high yield will already be in the hands of the commercial seed companies and these will be releasing the new material to the farmers. It is expected that the extension service will already have acquainted the farmers with the raw material by means of small plot demonstrations and hog and poultry feeding trials.

An alternative method for mounting this project would have been to organize it through the Research Department of the Ministry of Agriculture (EPE). This approach might have had certain advantages since EPE is a national organization with research facilities in all parts of the country. Purdue's prior experience with high-lysine corn and firmly entrenched relationship with the UFV, however, tilted the balance in favor of that institution. Good relations have been established among EPE, the UFV, other universities and the private seed trade, and there is close cooperation among all of these entities.

COURSE OF ACTION

The targets to be attained by this project were stated in Section I. The course of action agreed to is as follows:

1. Continue to build up the collection of germ plasm from various sources both within and outside Brazil and to test this material for protein and amino acid content yield, and other characteristics, with a view to its use in the development of new hybrid and synthetic lines adaptable to Brazil.

2. Proceed with the second and subsequent selection cycles (based on the results of the first cycle which has been completed) on the basis of lysine content per unit area. The purpose is to produce a high-lysine synthetic variety as soon as yield (as compared with a standard control) is satisfactory. It will probably be possible to plant an increase population in May 1970, and to have limited amounts of a synthetic Opaque-2 variety ready for release to farmers in September 1971.

The corn breeding work is on schedule. The first backcrosses of 127 inbred lines being converted to Opaque-2 were made in February 1969. Conversions of corn populations to Opaque-2 and Floury-2 are in backcross.

3. Continue tow work closely with private seed companies in developing high-lysine corn. The four largest seed companies are cooperating closely with the project and are breeding their own Opaque-2 hybrids. They have all received breeding material from the project. Agroceres, Brazil's largest seed company, has provided some breeding materials to the project in return. Agroceres expects to have 70 tons of a double-cross Opaque-2 hybrid for release in June 1970. The Sementes Company will also have a double-cross Opaque-2 hybrid by that date but in an unspecified amount.

4. Cooperate with state and federal agencies and private companies in the development of high-lysine corn varieties and hybrids.

5. Assist in the planning of livestock feeding and other nutrition studies in order to encourage the use of high lysine corn for animal feeding to assist in more economical gains (pounds of meat per pounds of food).

6. Proceed with training activities designed to provide qualified technicians in the field of corn genetics. One Brazilian technician is already in the U.S. working on his Ph.D. in genetics. One of the six scheduled to study for an M.S. degree in Brazil has already started his studies at UFV.

BULTON

NONCAPITAL PROJECT FUNDING (Obligations in $000) Annex A

Table 1
Page 1 of 2 pages
COUNTRY: BRAZIL

PROP Date: Dec, 1969
ORIGINAL: X
Rev. N?:

Project Title: Development of High Quality Protein in Corn

Project N?: 512-15-130-247.3

Fiscal Years	A/	L/G	Total	Cont 1/	Personnel Serv. AID	Personnel Serv. PASA	Personnel Serv. Cont	Participants U.S. Agen.	Participants Cont	Commodities U.S. Agen.	Commodities Cont	Other Costs U.S. Agen.	Other Costs Cont
Prior thru Actual FY 69	AG	G	211	201	-	-	141	-	-	-	29	-	31
Operational FY 70	AG	G	140	119	21	-	51	-	26	-	15	-	27
Budget FY 71	AG	G	118	96	22	-	53	-	-	-	15	-	28
B + 1 FY 72			-										
B + 2 FY 73			-										
B + 3 FY 74			-										
All Subs Yrs			-										
Total Life	AG	G	459	416	43	-	245	-	26	-	59	-	86

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$ Equivalent (000's)
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Project No: 512-15-130-247.3

Fiscal Years	AID-controlled Local Currency U.S. owned	AID-controlled Local Currency Country owned	Other Cash Contribution Cooperating Country	Other Donor Funds ($ Equiv.)	Food for Freedom Commodities Metric Tons (000)	Food for Freedom Commodities CCC Value & Freight ($000)	Food for Freedom Commodities World Market Price ($000)
Prior thru Actual FY 69		8	15				
Operational FY 70		37	10				
Budget FY 71		41	12				
B + 1 FY 72							
B + 2 FY 73							
B + 3 FY 74							
All Subs Yrs							
Total Life		86 1/	37				

1/ Trust Fund

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TO – AID/W TOAID A 623

FROM – Rio de Janeiro

SUBJECT – NONCAPITAL PROJECT PAPER (PROP)
Development of High Quality Protein in Corn
REFERENCE – 512-15-130-247.3

Farmer's Research

REFERENCE: PROP Review Session with Mr. A. Hughes, USAID/Rio
June 18, 1970

1. In accordance with the recommendations resulting from reference review meeting, the Mission hereby submits the following revised target section to the existing PROP (page 4) for the Development of High Quality Protein in Corn project:

XXXXXXXXXXXXXXXX

2. "The planned targets for the project are as follows:

a) Incorporate into adapted Brazilian corn hybrids and varieties the Opaque-2 and Floury-2 genes to improve protein quality.

b) Stimulate the use of these improved corn stocks in corn breeding programs at institutions, both private and governmental, so that 100 tons of high quality lysine corn seed will be available by the planting season October/November 1970 for the production of double-cross hybrid seed which in turn will make 1000 tons available for selected farmers in 1971 for grain production.

c) Conduct necessary nutritional tests to determine the feeding value of corn varieties for humans and animals.

d) Strengthen the capability of the Federal University of Viçosa for carrying out corn genetic research and to establish at the University a competent protein analysis and amino acids testing laboratory to be in full operation by project phase out (approximately December, 1971).

PAGE 1 OF PAGES 2

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It is also expected that by 1971 the University will have an established program capable of continued training of future students in this type of research."

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3. Target No. 4 of the previous PROP submission - Train two Brazilian scientists in corn genetics to the PhD level in the U.S, and six to the M.S. level in Brazil and train other Brazilian technicians in corn genetics and biochemistry through short-courses and on-the-job instruction. - has been deleted from the above re-drafted target section. The Mission concurs with AID/W's contention that training activities should not be considered as final goals in themselves, but rather, as project inputs, a means towards achieving the project's targets.

4. Target No. 6 of the previous PROP submission - Foster cooperation between private industry, universities and governmental institutions based on a common interest in improved corn. - has also been deleted from the Mission's re-draft of the target section of the PROP. This should be considered as a project activity (in the Course of Action section of the PROP) for the attainment of the overall project goals.

5. Finally, it should be noted that it is anticipated that the benefits resulting from the effortsof the High Quality Protein in Corn project will be incorporated into two other Mission assisted activities, the Feed Grains Program and the School Lunch Program, beginning early 1972.

BOONSTRA