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CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) — PART I

Report Symbol U-44

1. PROJECT TITLE	2. PROJECT NUMBER	3. MISSION/AID/W OFFICE
Development of Improved Varieties of Soybeans	931-0560	DS/AGR

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 1

☐ REGULAR EVALUATION ☒ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES	6. ESTIMATED PROJECT FUNDING	7. PERIOD COVERED BY EVALUATION
A. First PRO-AG or Equivalent FY ___ B. Final Obligation Expected FY ___ C. Final Input Delivery FY ___	A. Total $ ___ B. U.S. $ ___	From (month/yr.) March 1975 To (month/yr.) March 1979 Date of Evaluation Review June 17-22, 1979

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
1. Improved communications, i.e., multilanguage newsletters, etc.	Illinois	June 1980
2. Personalized status reports and scope of operations to A.I.D. Missions on a periodic basis	DS/AGR Illinois	April 1980
3. Facilitate relationships with AID/W regional offices	DS/AGR Illinois	March 1980
4. As solutions to problems are identified, assess ranking of next set of problems to be addressed	Illinois	Continuous
5. Narrow objectives of breeding program, i.e., seed quality, and development of disease; nematode and insect resistant varieties	Illinois	May 1980
6. Evaluate Rhizobium japonicum strains for tropical environment adaptation (cooperate w/DSB/SWM BNF Consortium)	Illinois	June 1980
7. Provide more attention to production aspects (agronomic) of crop production systems	Illinois	July 1980
8. Priority emphasis on Objective 5 should be given to harvesting, handling, and storage of seed that will be used as a seed source for the following year	Illinois	March 1980
9. Revised project statement A.I.D. Review RAC Review Contract Office		Nov 1978 Feb 1978 Jul 1979 Nov 1979

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- ☒ Project Paper
- ☐ Implementation Plan e.g., CPI Network
- ☐ Other (Specify)
- ☐ Financial Plan
- ☒ PIO/T
- ☐ Logical Framework
- ☐ PIO/C
- ☐ Other (Specify)
- ☐ Project Agreement
- ☐ PIO/P

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. ☐ Continue Project Without Change
- B. ☒ Revise ~~Extend~~ Project Design and/or ☐ Change Implementation Plan for 1-yr. extension
- C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

J. Yohe, Project Manager
DS/AGR, MMoryuski
DS/AGR, JWilson
DS/AGR, DPeterson

12. Mission/AID/W Office Director Approval

Signature

Typed Name: T. Babb, DAA/DS/FN

Date

AID 1330-18 (3-78)

PROJECT EVAULATION SUMMARY (PES) PART II

13. SUMMARY

Excellent progress has been made in all areas of responsibility. A worldwide phased system of variety testing is in place. Promising work on the identification of soybean germplasm resistant to soybean mosaic virus (SMV) has uncovered two crosses, each with a dominant allele for resistance to SMV. Cooking methods, rather than variety, appears to be more important in the cooking quality of selected varieties of soybeans with the use of bicarbonate solutions increasing the tenderness of soaked and cooked soybeans nearly threefold.

A Collection of Rhizobium japonicum strains has been assembled and is being maintained at the INTSOY Microbiology Laboratory in Puerto Rico. Research was conducted on the ability of R. japonicum strains to survive at elevated soil temperatures found in the tropics and subtropics and on the rates of R. japonicum needed to produce inoculum economically. Alternatives to peat as an inoculum carrier were studied and treated coir dust shows promise. An alternative low energy method for sterilizing plant containers used in Rhizobium quality control and research was developed.

Basic information systems on soybean germplasm, literature, and arthropods are serving soybean workers in LDCs. Information on current and projected world soybean production and trade is being generated. The economic potential for LDCs to commercially process soybeans for oil, meal, and food products is being studied. Plans to address the serious problem of soybean rust in Asia were formed in collaboration with workers in that area, and the "rediscovery" of the disease in this hemisphere underscores the need for more information on the nature and potential for control of the disease. A Regional conference on irrigated soybeans has been planned to be held in Egypt in September 1979. A newsletter and publications series brings information on a wide range of soybean activity to the growing number of soybean workers in the LDCs of the tropics and subtropics.

Progress has been made in defining the pathological problems affecting soybean seed quality in the field and in storage. Certain microorganisms were shown for the first time to cause serious problems in the maintenance of high quality soybean seed. Seedborne fungi are now recognized as having a greater influence on soybean seed quality than was earlier known. Several seedborne fungi that could be a potential threat to soybeans were reported for the first time.

A number of studies on the epidemiology of soybean mosaic virus (SMV) added to the sum of knowledge about this important soybean virus. A

program has been developed to produce virus-free seeds for introduction in Nigeria for breeding programs and distribution to cooperators in Africa. Studies have been made and are continuing on the identification of SMV strains, prevalent in various LDCs, their biological properties, and their transmission by seed or insect vector. Genetic research on bean golden mosaic virus (BGMV) established that it was the first plant virus with a single-stranded DNA genome.

Concurrent research was conducted on management control techniques for aphids and thrips. Promising sampling methods were developed to predict aphid movement. The role of phytophagous thrips in soybean production was studied relative to population density, distribution patterns, flight activity, colonization patterns, and sex ratios. Nine pest management studies were under way or in discussion stages with collaborators in six countries, to extend the field research to soybean producing areas in LDCs.

Cooperative research at UIUC and UPR/MC evaluated tropical storage properties of soybean seed. Seed viability declined rapidly to almost zero after nine months of improper storage in a tropical environment. Loss of seed viability was associated with marked gains in seed moisture during storage. Containers were evaluated for ability to maintain seed with no moisture gain. Sealed metal containers or plastic bags placed in metal containers with covers offered adequate storage protection for seed with a low initial moisture content.

Upon recommendation of AID's Research Advisory Committee (RAC), home and village level processing research was discontinued under the research contract and a final report on these activities was submitted. During the six-month phase out period a procedure for preparation of a low technology soy beverage was completed, filtering devices required for the preparation of the soy beverage were evaluated, and a simple device for separation of cracked soybeans into hull and cotyledon fractions was designed, constructed, and evaluated.

Results of research done under, and in cooperation with, this contract have been widely published in professional journals and other scientific publications.

14. EVALUATION METHODOLOGY

This was an in-depth evaluation. A regular evaluation was prepared on November 26, 1975 covering the period April 1974- March 1975. There have been no subsequent regular evaluations or in-depth team evaluations of this project until this review. The purpose of the review was to make recommendations for future actions with this project, to clarify the project design, measure progress, and to improve implementation. The scope of work was approved by DS/PO and the DAA/DS. The primary sources of data were the annual reports for 1977, 1978, and 1979, the project statements for extension

dated 4/1/76 - 3/31/79 and for 4/1/79 - 3/31/82. Detailed reports by individual project personnel through written and tabulated summaries and slide presentations were used also. Field visits took place to laboratories, greenhouses, and field nurseries after the oral presentations. The team was composed of Dr. B. E. Caldwell, North Carolina State University; Mr. Boyd Whittle, Africa Bureau; Dr. Maurice Peterson, University of California; and Dr. Carleton Infanger, Development Support Bureau. The team held an evening critique after each day's presentation and the morning of June 22 was devoted to reaching a consensus on major issues and to draft the outline for the evaluation report.

15 EXTERNAL FACTORS

There have been no major changes that have had any major impact upon the project

16. INPUTS

There were no problems with commodities, technical services, training, or other inputs as to quality, quantity, or timeliness of inputs. No changes are needed in the type or amount of inputs required.

17. OUTPUTS

The outputs, as designated in the project design, are discussed below.

1. Development of Improved Genetic Materials for Use in LDC Breeding Programs.

There is clear evidence that genetic materials distributed or produced by this project are finding success in a number of LDCs. Examples are substantial orders for soybean seed of specific varieties that have performed well in Initial Soybean Evaluation Variety Experiments. For example: since 1976, Egypt has purchased about 2000 tons of soybean varieties found to be adapted to their conditions; Syria, Pakistan, and Iraq have purchased about 100 tons each and ten other countries have obtained smaller quantities for seed increases; and the Philippines have established commercial production on about 5000 acres. The support level appears to have been adequate in the past and the review team concludes that a similar level of support is appropriate for the next three years.

The soybean breeder at Puerto Rico presented a clear and carefully considered list of breeding objectives. Field work was impressive both in scope and design. The review team believes the total list of breeding objectives exceed the available time, support, and talents of one plant breeder and that breeding goals should be trimmed to specific achievable goals. Major objectives should be release of adapted germplasm for LDC breeders. Those having highest priority were identified by the breeder as (1) seed quality, (2) disease resistance (principally soybean mosaic virus), and (3) insect resistance (principally stink bug). The team is

of the opinion that the breeder should develop a schedule of activities for the next three years (to the end of the current project extension) for the above three objectives which will provide a usable breeding line to breeders in the LDCs within this time span. Other objectives of lower priority can be continued at a slower pace to allow for the major goals to be reached.

Breeding for improved nutritional qualities (qualities originally suggested by BAC) does not appear to justify much emphasis because (a) a more critical problem is to gain adoption of soybeans as a crop in LDCs, (b) soybean nutritional quality is already very good and (c) important differences in quality among varieties is not clearly evident. Promising materials could be screened for total protein.

2. Improved Technologies for Rhizobium Management in the Tropics.

A qualified and energetic Ph.D. in microbiology is at work in Puerto Rico and is producing positive results. Accomplishments include (a) an ingenious system for determining the basis for any deterioration of inoculation cultures in international shipping, (b) methods of more successful inoculation methods in tropical soils, and (c) yield benefits from inoculation. The team believes he can now move on to other rhizobia problems including preliminary studies of strain efficiency.

A good microbiological laboratory has been developed at the University of Puerto using space provided by the University. The review team was well pleased with the progress of this objective.

3. Expansion, and Management of Knowledge on Soybean Production, Protection, and Utilization.

The review team viewed this objective as having two functions: (1) assembly and dissemination of knowledge currently available and (2) developing new information on those diseases, insects, or weed problems that are critical to the success of soybeans. Assembly of knowledge on insects found where soybeans are grown has been commendable, and is currently being utilized to assist in identification of insects in other countries. However, further effort on discovery of rare insects, while of academic interest, may not be very essential to this project. Therefore, attention and support could be directed more heavily toward disease and weed problems. The weed component is funded under a seperate 211d project at the University of Puerto Rico. This project will expire before the University of Illinois contract. An effort should be made to continue this research. Current knowledge of the weeds and their control in soybeans should also be available from the Oregon weed control project, and should be utilized by INTSOY in conjunction with the 211d Puerto Rico weed project.

The team has some concern that the SMV work may be pursued beyond that called for as a part of this project and suggests the project management

be prepared to make shifts to other areas at the appropriate time. An effort should be made to utilize the results and resistant germplasm for viruses becoming available from USDA programs at Stoneville, Mississippi and Raleigh, North Carolina.

4. Improved Knowledge Base for Disease Control in Soybeans.

Excellent progress has been made in defining some of the pathological problems affecting soybean seed quality in the field and in storage. Certain microorganisms were shown, for the first time, to cause serious problems in the maintenance of high quality soybean seed. Seedborne fungi are now recognized as having a greater influence on soybean seed quality than was earlier known. Several seedborne fungi that could be a potential threat to soybeans were reported for the first time. Plans to address the serious problem of soybean rust in Asia were formed in collaboration with workers in that area, and the "rediscovery" of the disease in this hemisphere underscores the need for more information on the nature and potential for control of the disease.

A number of studies on the epidemiology of soybean mosaic virus (SMV) added to the sum of knowledge about this important soybean virus. A program has been developed to produce virus-free seeds in Nigeria for distribution to cooperators in Africa. Studies have been made and are continuing on the identification of SMV strains prevalent in various LDCs, their biological properties, and their transmission by seed or insect vector. Basic genetic research on bean golden mosaic virus (BGMV) established that it was the first plant virus with a single-stranded DNA genome.

5. Development of Model Insect, Weed, and Disease Control Management Systems.

The idea of development of integrated systems of pest management is not only highly commendable, but appears to have been very successful as it applies to insects. Evidence shows that integrated pest management was being successfully used on farms in South America on a large scale, and that this has resulted in a 75% reduction in pesticide use with no apparent effect on yield. In Brazil in 1978-79, an early warning system on insect infestation utilizing television reached about 25,000 farmers and resulted in a reduced pesticide use. The fact that healthy and vigorously growing crops are less injured by pests than non-vigorous ones indicate that more attention be given to agronomic problems of getting good stands, virorous seedlings, adequate plant nutrients, timely irrigation (where needed), etc. Therefore, the cultural aspects of production systems need more attention.

A secondary issue is whether or not it is possible for a centrally funded and operated project to develop production systems usable under the great variety of conditions in the LDCs. With this question in mind, the review team suggests management systems deal only with principles, i.e., how to produce good planting seed, characteristics of a good soybean seedbed, fertilizer requirements, etc., allowing for development of specific methods to the LDCs. Mission programs can take over and develop a system designed to fill a specific need with Illinois as the resource. The team recognized the benefit to this objective by the University of Illinois participation in a multi-university domestic Integrated Pest Management Program for soybeans.

6. Develop Improved Seed Storage Technology

The problem of getting good stands was identified as one of the principal problems with establishing soybeans as a crop in the LDCs. As mentioned in comments under Output 4, the agronomic aspects of this problem have received little attention. Production of better quality planting seed is being pursued under the breeding program. Seed storage problems have been successfully studied, but further problems exist. The team complements the project management for establishing a relationship with the USAID/ Mississippi Seed Project and encourages the continuation of this relationshi

18. PURPOSE

The purpose of the project is to develop and exploit the inherent potential of the soybean as a source of high quality protein and edible oil for the diets of rural and urban poor. The end of project status (EOPS) condition is (a) national programs of soybean production and use in LDCs, (b) use of improved soybean varieties exhibiting high yield and pest resistance characteristics.

The development of linkage to national programs has always been an important element of the project. General memorandums of understanding and letters of agreement have been executed with several international and cooperating country organizations to provide for specific projects and activities. These include IITA in Nigeria, AVRDC in Taiwan, the Ministry of Agriculture and Fisheries in Korea; and the Ministry of Agriculture Research Organization, EMBRAPA, in Brazil. Besides these formal relationships, the project has developed informal ties with a large number of organizations and individuals through correspondence and personal contacts. Examples of these relationships include institutions and individuals in 103 countries, established through the International Soybean Variety Experiment (ISVEX); IICA, Inter-American Institute of Agricultural Sciences of the Organization of American States (Costa Rica); and the Southeast Asia Regional Center for Graduate Study and Research in Agriculture-SEARCA (Philippines). Furthermore, INTSOY staff have participated in short courses

in LDCs given under the auspices of the AID/University of California Pest Management Project. In 1979, a course in soybean production, administered by the project will be given in Colombia for participants from Peru and Colombia. A project staff member will participate later this year at a week-long conference at CIMMYT in Mexico. The mailing list and newsletter of INTSOY has been used to announce and promote the two World Soybean Research Conferences - Urbana, Illinois, 1975 and N. C. State University, 1979. A number of additional similar examples could be cited to demonstrate the success of the project staff in establishing linkages with international and national institutions having interest in cooperating with the program.

As a result of competence built up by the contractor during the first few years of the project, countries and USAID Missions in two different regions became interested in having soybean development programs of their own. Projects are now being implemented in Peru and Sri Lanka with the University of Illinois as contractor. Support to country programs through Basic Ordering Agreements helped to establish linkages with nine different cooperating countries. These include assistance to a government effort to greatly expand soybean production in Uruguay, close collaboration with the National Research Organization (EMBRAPA) in Brazil to expand research, a Memorandum of Understanding with two universities in Iran to help with research and education in soybeans, and assistance to Korea with a crop development program intended to provide a technical bridge between temperate and tropical areas of the Orient and Asia. These earlier contacts have been helpful with the identification of problem areas and have had a direct beneficial effect in the implementation of this research project. As an additional example of how expertise is sought from the contractor, an African country, through the A.I.D. Mission, has very recently inquired as to how help might be provided to its fledgling soybean program through this project.

The nature of the project demands a continuing close relationship with many institutions throughout the world. Once a relationship is established, the task of keeping cooperators, researchers, and officials informed of on-going programs, places a great responsibility on project staff. USAID officials in Washington and in the Missions must also be kept informed. Project staff has performed notably in accomplishing this. Roughly 50% of all cooperators are visited by someone from the project staff throughout the year. Members of the staff are provided lists of cooperators in various countries, in order that they may be visited if someone from the project is in the country for any purpose.

Many cooperators are contacted only through correspondence. With personal visits limited, the project has provided information to interested institutions and individuals through the publication and distribution of a quarterly newsletter. This reaches roughly 1500 institutions and individuals. The newsletter is a useful instrument in the dissemination of information, but would be even more valuable if made available in Spanish and French, as well as English.

A great amount of correspondence is necessary in providing information and materials to cooperators and in making research results known. The contractor has principal responsibility in keeping A.I.D. officials in Washington and in the mission aware of what is being done in the various countries. In addition to the newsletters, copies of relevant correspondence is sent to agricultural officers in the missions and the DS/AGR project manager in AID/W receives copies of relevant correspondence between the contractor and country cooperators.

In order for USAID mission representatives to be aware of project activities in the countries in which they are located, it is important that agricultural officers receive copies of correspondence sent to host country officials regarding project matters. Project personnal should visit or call the agriculture offices immediately upon arrival in the country and discuss project activities and status. In view of the relatively high turnover of mission personnal, it would be helpful if a special or personal letter were sent to agricultural officers every six months giving a summary of the project and listing cooperators within that country.

Recently, the A.I.D. project manager, accompanied by the project director spent a day visiting each of the area geographic officers in AID/W for the purpose of providing orientation on the project. This is a commendable practice and should be continued. It would be even more useful if it were to be expanded to include the regional technical division offices.

19. GOAL/SUBGOAL

The goal for this project was to increase the welfare of both urban and rural poor. The objectively verifiable indicators to measure progress against the goal are (a) an increase in quantity of food available to the poor at reasonable prices and (b) increased income of small farm operators.

In Table 1, a comparison is made between 1970 and 1977 statistics for total area harvested (ha), production and value of production ($) of soybeans from nine developing countries. The data in the table shows that total dollar value of soybeans produced in these nine countries increased from $467,040,000 in 1970 up to $3,298,980,000 in 1977. The major increase was

Table 1. Comparison of Soybean Production, 1970 vs 1977, From Nine Selected LDCs

LDC	1970 (000) Ha *	1970 (000) Mt *	1970 (000) Value**	1977 (000) Ha *	1977 (000) Mt*	1977 (000) Value**
Egypt	0	0	0	8	15	4,200
Nigeria	162	61	17,080	190	70	19,600
Brazil	1,314	1,547	433,160	2,059	11,227	3,143,560
Equador	1	1	280	15	19	5,320
Peru	0	0	0	3	3	1,740
India	4	2	560	160	120	69,600
Iran	6	5	1,400	75	103	28,840
Philippines	1	1	280	15	11	3,080
Thailand	53	51	14,280	102	98	27,240
Total			467,040			3,298,980
Total (excluding Brazil)			33,880			155,420

* FAO Production Yearbook, 1977, Vol 31

** The average 1977 CIF price ($280/mt) was used as the comparison value between 1970 and 1977

Soybean trade on an international basis has been expanding at about 11 per cent per year over the past eight years, while soybean meal and oil trade has been growing at a rapid rate of 16 per cent per annum. Not counting Brazil, less developed countries have accounted for almost none of the export of these products and only 4-5 per cent of the import quantities for raw beans or meal. However in 1976, they imported almost 57 per cent of the soy oil traded in the world. Major LDC soy oil importers included India, Pakistan, Turkey, Morocco, Peru, Colombia, and Bangladesh. In addition to soy oil imports, less developed countries import almost all of the U. S. exports of corn-soy-milk blend and wheat-flour-soy-blend.

Current conditions in the world soybean market and country development programs are causing several nations to consider importing raw beans to be processed internally. The economic evaluation of these decisions hinges on the amount and mixture of internal demand for soy products, processing economies of size, internal production levels, and soybean versus meal and oil international transport costs. Countries planning to develop soybean processing capabilities must either erect import barriers or face competition from exports of large scale processing plants in developed countries. Modern soybean processing plants involve substantial capital, technical expertise, management competence and large quantities of various inputs. This process of transforming soybeans into meal and oil involves substantial economies of size particularly up to 1000 tons/day. When located in a developed country costs of processing soybeans in a

500 ton/day plant are approximately twice as high as processing the beans in a 2000 ton/day plant. However, in less developed countries where relative prices of labor and capital are different, the comparative advantage of a large versus small solvent extraction plant is less. To survive and compete effectively in the meal and oil market with large developed country processing plants, LDCs need to make up the processing cost disadvantages of smaller plants with lower raw soybean ocean transport costs relative to meal and oil ocean transport costs. Research is being done to ascertain the extent of this difference.

Products from solvent extraction plants need not be soy meal and oil only. High calorie soy oil is usually produced, but the meal residue may be used for high protein baking ingredients and additives, cereal products, beverage powders, and numerous other products for use as human food. With the large soy oil imports by LDC and their need for higher protein diets, demands for soy products derived from solvent extraction plants might be quite high in specific countries where soybean production is developing. A small 500 ton/day plant would require approximately 165,000 hectares of soybeans to be fully supplied for full time operation all year. Countries with less than this production area may still find investment in a processing plant profitable by importing raw soybeans to supplement developing production.

Factors found to be important in processing plant economic performance include: dependability of supply and price of imported and/or domestic soybeans; price and quality of imported competing soy products; cost and quality of bean and soy product storage; potable water, hexane solvent and labor quality, reliability, and cost; management competence; capital equipment acquisition costs; quantity and mixture of demand for soy products; suitability of location; and transport facilities to and from the plant.

The nine listed countries in Table 1, because they specifically have received assistance from the University of Illinois Basic Ordering Agreement (BOA) #1109 in the areas of providing consultant advice, training sessions, and program planning, have been helped to make rapid progress in improved soybean production. The formal linkages under this project through the Memorandum of Understanding with LDC institutions have been the major instrument for providing the relationship for supplying technical information for the outreach activities of the International Soybean Program (INTSOY).

20. BENEFICIARIES

The initial beneficiaries are the LDC national research programs. The project is a tool for developing soybean germplasm adaptable to tropical conditions. It has devised an information network and testing network that

links individual researchers together from over one hundred countries. The project will advise national programs if it is technical and potentially economical to produce soybeans in given areas. The real beneficiaries will be the LDC farmers as they capitalize upon adapted, high yielding varieties that are developed and dissemination through this project and its national cooperators.

21. UNPLANNED EFFECTS

There have been no unplanned effects that have interfered with the development of this project.

22. LESSONS LEARNED

This project has been very successful in achieving its goals. This is primarily because it is filling a need in the LDCs and because LDC scientists and LDC research station administrators around the world identify with it and look to it for leadership. This is because the project has been very successful in mobilizing participation in the planning and implementing of project activities at the local level.

23. SPECIAL COMMENTS OR REMARKS

The new three year proposal for extension was reviewed by BAC subsequent to this review. The BAC indorsed the extension and DS/AGR recommends to the agency that the project be extended through March 31, 1982 in order to fully realize the benefit from investments made to date.

DS/AGR will incorporate the recommendations of the evaluation team into the scope of work for the new project extension.

Attachments:
On-site Review and Evaluation Report of
Contract AID/ta-c-1294, Jun 17-22, 1979