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9. ABSTRACT

This terminal report of a ten-year contract period covers the period July through December, 1973. Principal activities entailed acquainting personnel of the University of Puerto Rico with the projects in progress and arranging for the administrative takeover by the University, under whose auspices the grain legume research will continue. Time was also spent in analyzing data from the various projects and preparing publications, as well as classifying and cataloging the seed collection. Studies were continued with bacterial blight of beans and cowpeas, and the role played by insects in the spread of these bacterial pathogens. Numerous collections were made of insects in bacterial blight-infected bean and cowpea plantings. Only a few insects commonly considered pests of the foliar portions of these two food legumes were found to be vectors of bacterial blight under natural field conditions in Puerto Rico. The most important insect vectors were Diaprepes abbreviatus and Cerotoma ruficornis. This report presents 25 summary statements of findings from a survey of diseases and pests of beans and cowpeas in Central America and the Caribbean. Also included are 17 statements of findings from research studies of fungal and bacterial diseases of these legumes. A tabular summary of the origins and numbers of cultivars assembled in the seed acquisition program and stored in the germplasm bank at FES, Mayaguez, Puerto Rico, is also presented. The final section of the report discusses short-term and long-term problems and complications associated with research on bean and cowpea pathogens in Central America, the Caribbean, Iran and India.

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IMPROVEMENT OF TROPICAL PRODUCTION OF BEANS AND COWPEAS THROUGH DISEASE AND INSECT CONTROL

(Grain Legume Production)

USDA/AID PASA RA (AJ) 3-00

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
INTERNATIONAL PROGRAMS DIVISION
HYATTSVILLE, MARYLAND 20782

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REPORT SUMMARY

A. 1. Project Title and Contract Number: Improvement of Tropical Production of Beans and Cowpeas Through Disease and Insect Control (extension of project entitled, "Grain Legume Production"), PASA RA (AJ) 3-00.

2. Principal Investigators, Contractor and Mailing Address:

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P.O. Box 70
Mayaguez, Puerto Rico 00708

3. Contract Period (as amended): From June 25, 1963, to December 31, 1973.

4. Period Covered by Report: From July 1, 1973, to December 31, 1973.

5. Total A.I.D. Funding of Contract to Date: $2,926,000

6. Total Expenditures and Obligations For Previous Contract Year: $163,000

7. Total Expenditures and Obligations for Current Year (FY 1974): $75,000

B. Narrative Summary of Accomplishments and Utilization:

The period July 1 to December 31, 1973, was spent in acquainting personnel of the University of Puerto Rico with the projects in progress and arranging for the administrative takeover by the University under whose auspices the grain legume research will continue. A considerable amount of time was spent in the analysis of data from the various projects and the preparation of reports and publications. A major effort was devoted to the classifying and cataloging of the seed collection and the storage of this material in the new walk-in cold storage facility.

Studies were continued with bacterial blight of bean and cowpea, and the role played by insects in the spread of these bacterial pathogens. Numerous collections were made of insects in bacterial blight-infected bean and cowpea plantings. Only a few insects commonly considered pests of the foliar portions of these two food legumes were found to be vectors of bacterial blight under natural field conditions in Puerto Rico. The most important insect vectors were *Diaprepes abbreviatus* and *Cerotoma ruficornis*.

NOTE: Monetary estimates given above are expressed to the nearest thousand.

In August 1973, N. G. Vakili conferred with bean specialists in seed companies at Twin Falls, Nampa, Paoma, Caldwell, and Boise, Idaho. Participated in the meetings of Western Regional Coordinating Committee on Bean Cultivation at Twin Falls, Idaho. Conferred with Drs. Wayne Adams and A. W. Saettler at the Michigan State University, East Lansing; visited IPD/ARS, Hyattsville, and TAB/AID, Washington, D.C.

During this period, N. G. Vakili was invited to join the committee on International Cooperation on Bean Rust Research. Dr. J. P. Meiners, ARS, USDA is the chairman of this committee. Also, N. G. Vakili was invited to serve as chairman and moderator of the working group on pathology at the IITA Grain Legumes Improvement Workshops which was being held at Ibadan, Nigeria, during October 29 to November 2, 1973.

In September 1973, W. J. Kaiser conferred with scientists at the Berkeley and Davis campuses of the University of California on the topic of bacterial diseases of legumes and attended the Second International Congress of Plant Pathology which was held at the University of Minnesota.

During December 9-14, N. G. Vakili and W. J. Kaiser attended the meetings of the Caribbean Division of the APS which were held at San Jose, Costa Rica.

TERMINAL REPORT

Grain Legume Improvement Project (Improvement of Food Legumes for the Tropics) PASA No. RA (AJ) 3-00.

A. General Background

Pulse crops (food legumes) are a major source of protein available for human consumption in developing countries. They provide a high quality protein to large segments of the population who do not consume animal protein for economic and/or religious reasons. Unfortunately, the levels of production in these countries are very low due to inherent characteristics of the varieties grown, damage from insect pests and diseases, and poor cultural practices.

A variety of pulses are grown in the Near East and Southeast Asia where they supply an important part of the protein in the diets of primarily cereal eating people. In Latin America, in contrast, food legumes constitute a significant portion of the daily diet of the population. Hence, even though large acreages are cultivated to these crops, the demand for these staple foods outstrips production. In an attempt to increase the production of high protein food legumes, the Regional Pulse Improvement Project was established in 1963 as a result of a Participating Agency Service Agreement (PASA) between the U.S. Agency for International Development (AID) and the Agricultural Research Service (ARS) of the U.S. Department of Agriculture (USDA). The purpose of the PASA in India and Iran was to have ARS conduct research in collaboration with the scientists of these host countries on varietal improvement, disease and insect control and cultural and management practices designed to increase production of food legumes in the Near East and Southeast Asia. Research activities began in Iran in 1965 at the Karaj Agricultural College of the University of Tehran, and in India in 1966 at the Indian Agricultural Research Institute at New Delhi. The purpose of the PASA project at the Federal Experiment Station (FES), Mayaguez, Puerto Rico, was to conduct research in a U.S. Government institution and share the results in collaboration with scientists of the countries in the region. The aim of the FES, Mayaguez project was to develop sources of resistance in beans and cowpeas to important endemic diseases and insect pests of tropical America and to distribute the multiple resistant cultivars for further tests and incorporation into local varieties by the collaborating institutions. Use of resistant varieties is frequently the only practical and economical method of disease control available to farmers in the tropics.

The project is also striving to assist Central American countries in developing their own legume improvement programs and methods of screening pulse crops for disease resistance.

B. Project Objectives

Puerto Rico The first objective of the project was to identify the diseases and insect pests of beans and cowpeas which were endemic to the tropics and especially in Puerto Rico. Also, it was essential to find out to what extent Puerto Rico represented the various climatic conditions and environments which abound in tropical America. Priority in research was assigned to the most important diseases and pests of the two crops. Continuous attention was paid to the collection of germplasm which was pertinent to the needs of the project. Effective screening methods which were applicable under tropical conditions were designed to select resistant accessions and hybrids. In these screening trials the goal was the highest grade of resistance attainable. At the same time, continuous attention was paid to securing sources of field tolerance to diseases and pests. Development of cultivars with resistance to a wide range of diseases and possibly a few insect pests was the major aim of this project. Collaboration with foreign scientists in screening, testing, breeding and developing high yielding multiple disease resistant cultivars was the final objective. Some of the byproducts of the collaboration objective was in the field training of the support technicians in Latin America and the firsthand exchange of the information at scientific meetings and workshops. Hiring and training of a nucleus of support technicians at FES, Mayaguez and gathering of the necessary equipment were essential for the attainment of some of the above objectives.

Iran and India To increase yields and improve the quality of several pulse crops through (a) breeding and selection of varieties adaptable to various regions; (b) improvement of cultural and management practices; and (c) development of pest control measures.

C. Continued Relevances of the Objectives

The project has pointed out the specific priority areas of research for disease and insect pest resistance for the improvement of food legumes in the tropics. Survey of tropical America and the subsequent research has shown that plant breeders and pathologists in the region are working with two bacterial blight pathogens (*Xanthomonas* species) of beans rather than one

which was considered to be the case before. The survey of diseases in Central America has indicated that a relatively unknown disease of beans, bean smut caused by an Entyloma species, is spreading both in Central America and in the Caribbean. The importance of whitefly-transmitted viruses in the lowland tropics was recounted in the surveys and greater attention was focused on this problem. Contacts with foreign agricultural institutions repeatedly indicated the need for more trained personnel in these organizations if greater improvement in food legume research was contemplated.

A few examples of the relevance of the project to the needs of the U.S. for better food legumes and protection against disease spread are presented below. The majority of the bean cultivars developed for resistance against bean common mosaic virus strains and rust races were also resistant under the U.S. conditions. Also, survey of the diseases in Central America suggested that one of the two bacterial blights of beans, bean smut and some of the whitefly-transmitted viruses of beans could easily spread into the Southern United States and endanger the cultivation of this crop.

D. Accomplishments, Puerto Rico

I. General

1. The accelerated pace by which field work and breeding schemes could be handled under the year-round tropical condition was both a major natural asset and a technical accomplishment of this project.

2. Taking advantage of the tropical climate, severe disease outbreaks could be incited and the host plants could be subjected to rigorous screening trials in the field.

3. The research project at FES, Mayaguez, Puerto Rico, served as a pivoting area for outreach to both English and Latin speaking countries of tropical America. The generous travel allowances and close cooperation of TAB/Washington and Rural Development offices in the Latin America and Caribbean made it possible to become familiar not only with diseases and pests of beans and cowpeas in these countries, but to become acquainted with the multiple facets of the socioeconomic problems involved in cultivating these crops.

4. The bean and cowpea germplasm of over 5,000 items was collected by the Food Legume Improvement project and is being screened in the field and greenhouse to locate sources of resistance to endemic tropical diseases.

5. Developed methods of screening for different diseases and insect pests of pulse crops in the greenhouse and field.

6. Helped to organize the bean improvement program for El Salvador in 1971.

II. Findings

A. Survey of Diseases and Pests

1. Two pathogenic types of Xanthomonas caused bacterial blight of beans in the lowlands of the tropical America. One type which appeared to be most prevalent in the lowlands was pathogenic to both beans and cowpeas.

2. The halo blight of beans (Pseudomonas phaseolicola) was encountered only in the tropical highlands (6,000 feet and above).

3. Bean smut was encountered for the first time in Chiapas state of Southern Mexico, Haiti, and Jamaica.

4. In Central America, bean smut was not pathogenic to cowpeas, rice beans, lima beans and scarlet runner bean, but was widely virulent on all bean cultivars in Central America.

5. Rust, virus diseases, bacterial blights, and soil-borne diseases were the major diseases of beans in the tropics.

6. In the tropical lowlands, the whitefly-transmitted viruses and web blight constituted two of the most severe diseases of beans, the former as a dry season disease, and the latter as a wet season disease.

7. Cowpea mosaic virus was the most prevalent and severe disease of cowpeas in the tropics.

8. The 1971-1972 survey of bean diseases in Central America indicated that the nursery and the advanced yield trial lines which were developed in tropical America, although many

had high yielding potentials, were susceptible to most of the endemic disease of the area. Some lines possessed susceptibility to 13 diseases.

9. Two nursery lines of beans, "Ecuador 299" and "Mexico 243" were the only cultivars in the Central American trials which possessed resistance to all endemic races of rust in the area during 1971 - 1972. Both cultivars were red beans.

10. Differential response to web blight infection was noticed among a few local bean cultivars in El Salvador.

11. A rugose bean virus which is transmitted by chewing insects was found throughout Central America and Southern Mexico. But, it was a minor viral disease of beans.

12. The "Witches-Broom" disease of pigeon peas which is caused by a mycoplasma-like organism was encountered for the first time in Puerto Rico.

13. The "Velvety" leaf spot of beans caused by the fungus Scoletotricum sp. was found in the highlands of Jamaica.

14. Gray mold caused heavy damage on pole beans cultivated for canning on the highlands of Chiriqui province, Republic of Panama.

15. Round spot of beans resulted in complete loss of beans on the central highlands of Honduras, Central America.

16. Anthracnose caused 80 to 90 percent loss in a large dry bean field in the highlands of Costa Rica.

17. Choanephora sp. caused a leaf blight of cowpea in the Amazon delta, Brazil.

18. A whitefly-transmitted virus disease of the soybeans which has Euphorbia prunifolia as its alternate host, caused a severe malformation and complete loss of yield of soybean in Leon, Nicaragua.

19. In Masaya, Nicaragua, several fields of lima beans were highly resistant to leafhopper damage, but severely infected with Golden Yellow mosaic virus. However, the latter infection did not seem to greatly affect their yields.

20. Leaf cutting insects, especially Chrysomelidae, leafhoppers (Empoasca sp.) and pod borers, especially Curculionidae, were the major insect pests of beans and cowpeas in the tropical America.

21. Cowpea weevil (Chalcodermus ebenines) was found to be the most important pest of this crop in the FES fields at Isabela, Puerto Rico.

22. A carpenter bee (Xylocopa brasilianarum) was the cause of high percentage of cross pollination in the field. This natural occurrence was utilized to produce multiple disease resistant beans.

23. Leaf webber (Lamprosema indicata) caused heavy damage to beans. Leaf webbing in combination with unseasonal rains which enhance bacterial blight infection caused complete loss of infested lines at Isabela, Puerto Rico.

24. Due to the seed set problem in beans at FES, Mayaguez, 14 selected hybrid lines and cultivars were sent to Dr. J. P. Meiners for hybridization at Beltsville, Maryland. Thirtyone crosses representing 25 combinations of parental material were made. A total of 214 F_1 seeds were harvested from these crosses. However, only 114 of the F_1 seeds germinated at FES, Mayaguez. The F_2 progenies were being tested for multiple disease resistance.

25. A number of fungal and bacterial isolates from diseased beans, cowpeas and other hosts have been included in the Food Legume Improvement Project's culture collection. These consist of 213 bacterial cultures (number isolated from bean: 108; cowpea: 52; insects: 22; and other hosts: 31) and 174 fungal cultures (comprising 109 isolates of Cercospora spp.; 22, Thanatephorus cucumeris; 7, Sclerotium rolfsii; 7, Phytophthora spp.; 6, Corynespora cassiicola; 3, Pythium spp.; and 20, other fungi).

26. A more detailed report of the survey findings are available in the libraries of the Federal Experiment Station, Mayaguez, and the University of Puerto Rico, Mayaguez campus.

B. Research

1. Inheritance of resistance to cowpea mosaic virus in cowpeas is conditioned by multiple recessive factors.

2. Two strains of cowpea mosaic virus, the yellow mosaic and the dull green mosaic are present in Puerto Rico. Data at hand suggest that resistance to the two strains is independently inherited.

3. Two types of plant characteristics in cowpeas conditioned resistance to cowpea weevil infestation. These were: feeding preference of adults for different cultivars and incompatibility of the host tissue with larvae.

4. The two bacterial blight diseases of beans encountered in tropical America corresponded in pathogenicity with the common bacterial blight of beans caused by Xanthomonas phaseoli, and the bacterial canker of cowpeas caused by Xanthomonas vignicola.

5. Two species of Cercospora, C. cruenta and C. canescens were the cause of Cercospora leaf spot diseases of beans and cowpeas in Puerto Rico.

6. Some Cercosporas isolated from different cultivated and weed hosts are pathogenic to V. unguiculata in greenhouse inoculation trials and indicate the importance of alternate hosts as reservoirs of the pathogen.

7. In addition to blustry winds and rains, chewing insects were also responsible for the dissemination of bacterial blight in both beans and cowpeas.

8. Two bean cultivars: La Vega, a hybrid developed at FES, Mayaguez, and Santa Ana, a local variety encountered in Masaya, Nicaragua, were resistant to both Rhynchosia mosaic and Abutilon mosaic which are whitefly-transmitted virus diseases. La Vega is a black and Santa Ana is a red bean.

9. Obtaining resistance against insect pests and insect transmitted viruses was much more difficult and time consuming than was the case with the pathogenic diseases.

10. No distinct case of resistance against the two bacterial blights has been located in beans as of the end of the project.

11. In cowpeas the most difficult source of resistance to secure was aginst cowpea mosaic virus which was followed by powdery mildew.

12. In cowpeas resistance was easily accomplished against bacterial blight or canker, Cercospora leaf spot diseases, and target spot (Corynespora cassiicola).

13. Locating of resistance in beans to rust races and mechanically transmitted viruses was easily accomplished. The greenhouse and field screening procedures utilized by the legume project have eliminated the importance of bean common mosaic virus (BCMV) as a limiting disease in the advanced breeding lines. Resistance to BCMV is routinely incorporated into lines which are being screened against different diseases.

14. During 1970-1971 breeding efforts produced 240 black-shiny hybrid bean cultivars which were especially selected for adaptability trials in El Salvador. Mr. Bernardo Patino visited FES, Mayaguez, in March 1971 and 46 lines which he selected were sent to El Salvador.

15. Advanced cowpea cultivars developed by the Southern States during 1971 were tested for adaptability and resistance to tropical conditions. Trials indicated that even though some cultivars had excellent agronomic characteristics for the tropical environment, they were susceptible to a number of diseases.

16. Field trials of the cowpea cultivars developed in the U.S.A. indicated that they yielded as much as or less than the selected tropical cultivars.

17. A more detailed summary of the results of research conducted at FES, Mayaguez, is presented in Appendices B, C, and D.

III. Assembling of Germplasm

Seed acquisitions in the germplasm bank at FES, Mayaguez, includes:

1. Phaseolus vulgaris

No. of cultivars	Origin
2,375	El Zamorano, Honduras (The Central American Collection of Dr. George F. Freytag)
1,049	PI accessions, USDA
99	Central American Legume Improvement Cooperation
26	Turrialba
18	Brazil
16	El Salvador
15	University of Puerto Rico
10	University of Nebraska
6	Nicaragua
4	Dominican Republic
4	Haiti
3	Australia
3,550	

2. Vigna unguiculata

No. of cultivars	Origin
530	PL accessions, USDA
178	University of the West Indies
168	University of Florida
34	Central American Legume Improvement Cooperation
28	University of Georgia
24	IITA
2	El Salvador
964	

There are also 117 accessions which belong to several food legume species in the germplasm bank. The total number of accessions in the germplasm bank at the termination of the project is 4,631 items. To this sum a rounded number of 750 items should be added which includes line selections and hybrid progenies obtained from screening and breeding work. The total number of seed items in the germplasm bank at FES is about 5,381.

Appendices A and B provide information on some of items in the germplasm bank. The "Entry No." in these tables refers to the FES, Mayaguez registration number.

IV. Complications

A. Short Term Research

1. The problem of seed set in the hand pollinated bean crosses needs to be solved. Hundreds of crosses were made under different conditions in an insect-free greenhouse, but pollinated pods either fell or failed to set seed. The progress of the specific disease resistance studies in beans is dependent on the success of pollination.

2. The symptoms caused by the two different bacterial blight pathogens on beans are in need of growth chamber characterization. This exact knowledge on symptomology shall assist in field screening of varieties to the two diseases.

3. Disease resistance alone is not the answer for achieving high yields in beans and cowpeas in the tropics. Concerted efforts should be placed on the chemical control of bacterial blights and web blight diseases. Viruses transmitted by whiteflies or chewing insects should be controlled with insecticides. Both safe, cheap and easy methods are needed to assure success of application by the small farmers.

B. Long Term Research

1. In most of the Latin American countries beans are grown as a subsistence crop with at least 60 to 70 percent of the tonnage produced in this manner. The increase in population, industrialization and city-ward immigration is increasing the demand for beans and all other commodities. However, cultivation of beans in the tropics, in its passage from subsistence to commercial cultivation is encountering two divergent sets of problems.

   a. Cultivation of beans in the intermediate highlands, which is the traditional area of planting, is threatened by the cultivation of more profitable crops. Hence, more and more marginal lands are assigned to beans. This, in addition to the usual need for disease and insect resistance, requires more sturdy and high yielding lines. At the same time, the commercial chemical control of diseases and pests becomes much more expensive when steep hills and rocky ravines are involved.

   b. The major acreage of tillable flat land in the tropics is located below an elevation of 500 meters. This is either a hot and wet or a hot and dry climate which is adverse to bean cultivation. The majority of bean

cultivars produce low yields at this low elevation are are subjected to severe disease outbreaks. However, if commercial bean cultivation is to be successful in the tropics, it has to use modern technics which require at least a rolling land. Again in the lowlands, beans have to compete with other crops for profit. For example a farmer on the Pacific lowlands of El Salvador may reap 600 pounds per manzana in beans, which at 30 centavos will earn his 180 colones, whereas in an adjacent field another farmer may reap 4,800 pounds per manzana in cowpeas. Even at 10 centavos, he will earn 480 colones per manzana. Hence, either the price of beans has to go up in order to compete with other crops or high yielding, heat resistant, and disease resistant bean cultivars have to be developed. This will require several years of breeding work.

2. Control of insects and disease. The omnipresence of a multitude of insects and pathogens and the small size of farms (minifundas) render, especially insect control, a difficult and uneconomic task for the small farmers. This condition in the tropics will not change in the foreseeable future. Hence, national schemes for insect and disease control are needed if substantial increase in yield is desired.

V. Interpretation of Data and Supporting Evidence

During the 4-year period the project has been in operation, results indicate that germplasm of beans and cowpeas can be identified by growing large numbers of lines of diverse origin under conditions of natural epidemics to diseases in the tropical environment of Puerto Rico and then subjecting the field resistant lines to further screening under more controlled conditions in the greenhouse. Subsequent evaluation of several of these lines in Central America tend to confirm the hypothesis that germplasm resistant to a given disease in Puerto Rico will be resistant also in Central America. Thus, a program for development of resistant germplasm for Latin America can be successfully carried out from a U.S.-based tropical location such as Puerto Rico.

VI. Research Design

There will be little change in the research methods that have been utilized by the project. New or different techniques will be incorporated into our research program when they will enhance the progress of our research. Greatest emphasis will be devoted to the study of diseases of most importance to the cultivation of beans and Southern peas in the tropical areas of Latin America, and developing germplasm of these crops which is resistant to these limiting diseases.

E. India and Iran

The accomplishments of these two projects have been presented through publication of results in annual reports, bulletins and scientific journals or at several workshops and seminars and in the terminal report of these two projects.

F. Dissemination and Utilization of Research Results

I. Dissemination of Results: Results of research have been published in scientific journals and presented orally at various scientific meetings and technical conferences. (These publications are available in the libraries of FES, Mayaguez and at the University of Puerto Rico, Mayaguez campus). Germplasm has been widely disseminated to food legume workers throughout the world.

Trip reports on the survey of bean diseases and bean and cowpea cultivations in Central America, northern South America and the Caribbean have been distributed to all interested institutions and U.S. Government agencies.

II. Examples of the Use of Findings: One bean line, "La Vega" which was found by project personnel to have resistance to several diseases, including Rhynchosia mosaic virus, is being tested in several countries of Latin America. Germplasm developed by the project has been requested by different legume researchers in the tropics to be included in their field trials. See Appendix C for details.

A close working relationship has been established with the coordinator of the PCCMCA Central American Uniform Legume Tests to provide additional entry into the Central American countries. Additional contacts have been made with scientists associated with the International Research Centers in Columbia (CIAT) and Nigeria (IITA). A continuing effort also has been made to keep local AID Mission personnel well-informed of our activities and to seek their advice and cooperation. These activities can be carried out under the current provisions of the contract.

III. Release Notes and Manuscripts: In addition to the release notices described in Attachments 1-5, the following announcements and manuscripts have been sent to appropriate ARS editors for review:

A. Release Notes

1. Notice to plant breeders of the release of fourteen selected rust resistant bean lines.

2. Notice to plant breeders of the release of three cowpea breeding lines resistant to cowpea mosaic virus.

B. Manuscripts

1. Hybridization of Beans by Carpenter Bees. 1974, Environmental Entomology (in press).

2. "Witches-Broom" Disease Caused by Mycoplasma-like Organisms of Pigeon Peas (Cajanus Cajan) in Puerto Rico. 1974, Plant Disease Reporter (in press).

3. Disease Resistant Southern Pea Cultivars.

4. Bacterial Blight of Beans.

5. Field Screening of Southern Peas for Cercospora Leaf Spot Resistance.

6. Varietal Resistance of Southern Peas to Cowpea Weevil in Puerto Rico.

ATTACHMENT 1

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Washington, D.C. 20250
and
Agricultural Experiment Station
University of Puerto Rico
Mayaguez, Puerto Rico 00708

RELEASE OF DRY BEAN VARIETY, LA VEGA

The Agricultural Research Service, United States Department of Agriculture, and Agricultural Experiment Station of the University of Puerto Rico announce the release of the dry bean variety, La Vega.

The portion of the project carried out by USDA is supported in part by the Agency for International Development under a contract (PASA AJ 3-00) entitled "Regional Food Legume Improvement."

The variety La Vega is semi-vine, high yielding and intermediate in maturing. Its stiff and upright stem branches moderately and becomes maroon to purple at maturity while bearing dark green foliage. The dull black beans are intermediate in size, slightly flattened, and weigh 27.0 grams per one hundred seeds. Flowering starts from 30 to 32 days after sowing and purple pods mature into a brown color at 70 to 72 days.

La Vega resulted from a bulk selection of five plants from a line of PI 287536 accession (country of origin, Holland) which was cultivated at Isabela, Puerto Rico, during 1970. The five plants were free from any virus disease symptoms while the rest of the plants in the same row were affected. Due to frequent visitation of the flowers by a carpenter bee (Xylocopa brasilianorum L.) in the bean fields, it is possible that the five selected plants were putative hybrids of the accession PI 287536, their material parent. In 1971 further field selection was made under high disease pressure of Rhynchosia mosaic virus. The bulk seed from this selection was designated as R-19. Seedlings of R-19 were further screened in an insect proof greenhouse with large populations of viruliferous whiteflies (Bemisia tabaci Genn.) transmitting Rhynchosia mosaic virus from the adjacent severely affected R. minima (L.) DC. plants which were used as virus reservoir.

This variety besides having resistance to Rhynchosia mosaic virus (known in Latin America as "Enanismo" or "Achaparamiento") is also highly resistant to common bean mosaic virus an aphid transmitted virus disease, and the cowpea mosaic virus, a beetle transmitted

virus. In the field it indicates some tolerance to Golden Yellow mosaic virus which is another agent transmitted by Bemisia tabaci.

Variety La Vega has been a "slow ruster" in the field and has displayed type "2" pustule reaction to the races of rust (Uromyces phaseoli (Pers.) Wint. var. typica Arth.) present in Puerto Rico. It has shown a high degree of tolerance to the complex of soil borne diseases endemic in tropical soils and consistently has produced excellent seedling stand and root system under the humid weather conditions. La Vega is highly susceptible to the "Tropical Halo Blight" which is caused by Xanthomonas vignicola Burk., and susceptible to common bacterial blight (X. phaseoli (E. F. Smith) Dows.). It is also susceptible to web blight (Thanatephorus cucumeris (Frank) Donk.), angular leaf spot (Isariopsis griseola Sacc.), and cucumber mosaic virus.

The variety La Vega is highly adapted to tropical climate and should be an appropriate dry bean variety for cultivation at "La Postrera" planting season, when beans are sown at the end of the rainy season, mid-October, and harvested in early dry season, mid-January. For the latter part of the rainy season, it has root rot resistance and for the dry weather, with its high insect population, it has resistance to a number of virus diseases which are transmitted by whiteflies, aphids and beetles.

Seed will be available on a pro-rata basis to qualified persons who request it in writing on or before June 30, 1974 from N. G. Vakili, Federal Experiment Station, Post Office Box 70, Mayaguez, Puerto Rico 00708.

Approved:

Director Agricultural Experiment Station University of Puerto Rico	11/21/73 Date	Administrator Agricultural Research Serv.	12/6/73 Date

ATTACHMENT 2

United States Department of Agriculture
Agricultural Research Service
Washington, D.C. 20250

Notice to Plant Breeders of the Release
of three Dry Bean Hybrids
with Multiple Disease Resistance Characteristics

The Agricultural Research Service, United States Department of Agriculture announces the release of three dry bean (Phaseolus vulgaris L.) hybrid cultivars possessing a high degree of resistance, under tropical conditions, to a number of diseases.

This work is supported in part by the Agency for International Development under the project number (PASA AJ-3-00) entitled "Regional Food Legume Improvement."

The environment of the tropical lowlands is unfavorable to the cultivation of beans. Continuous warm weather, heavy seasonal rainfalls alternated by dry periods, rapid growth of weeds, a multitude of ever present insect pests and vectors, and the pressure of soil borne and foliage diseases drastically reduce the stand, vigor and the yield of beans. Cultivars with multiple resistance are needed, if cultivation of beans in the lowland tropics are to be an economic feasibility.

In Puerto Rico the development of hybrid beans with wide range of disease resistance was facilitated by a high frequence of open pollination in the field, caused by the visitation of the flowers by a Carpenter bee (Xylocopa brasilianorum L.) and by the possibility of growing four hybrid generations per year. Due to open pollination by the bees, only the maternal parents of these hybrids are known. The three hybrid cultivars were originally selected for cultivation in Latin American countries where black shiny beans are favored. They were also selected for tolerance to warm weather during flowering.

The hybrid cultivars being released are:

1. Cultivar designation: PR-H-71-1-R101.

Cultivar PR-H-71-1-R101 originated from a black dull seed and vine type, maternal parent from PI 200956 which was acquired from El Salvador. The black shiny F_2 progeny was screened for common bean

mosaic virus resistance. The F_3 and F_4 progenies were screened for common bean mosaic virus and rust resistance. The cultivar was bulked and increased at the F_5 generation. It has a vine habit, flowers at 47 days and has a small Navy bean-type black shiny seed.

2. Cultivar PR-H-71-1-R113.

The maternal parent of this cultivar is PI 289377 which has black dull seed, vine habit, and was acquired from Hungary. This cultivar was screened and selected as the previous one and increased at the F_5 generation. It has black shiny seed, semi-vine habit and flowers at 47 days.

3. Cultivar PR-H-71-1-R136.

The maternal parent of this hybrid is PI 195364 which has black dull seed, vine habit, and was acquired from Guatemala. The black shiny seeded hybrid was screened and selected as the previous ones and increased at F_5 generation. It has Navy bean-type seed, semi-vine habit and flowers at 47 days.

All three cultivars were resistant to:

Common bean mosaic virus. The three hybrid progenies were repeatedly subject to field and greenhouse screening in Puerto Rico and finally at Beltsville against strains BV-1, PR-5 and PR-9. These cultivars were free from infections in two seasonal field trials in El Salvador.

Seedlings of the three cultivars were resistant to Puerto Rico cowpea mosaic virus which is similar to the Arkansas cowpea mosaic virus. This virus is transmitted by chewing insects and is one the most prevalent diseases in the tropics. Also, seedlings of these cultivars were resistant to a strain of cucumber mosaic virus which affects a number of bean cultivars in the tropics.

Rust (Uromyces phaseoli var. typica). The three hybrid cultivars were screened for rust resistance at the F_3 to F_5 generations. During the past three years, these cultivars have been resistant to rust races which severely infect all North American rust differential bean varieties. At Beltsville PR-H-71-1-R113 had an immune response while the other two cultivars were resistant. At San Andres, El Salvador, these cultivars were moderately resistant while in New South Wales, Australis they had a resistant reaction to rust inoculation.

Fusarium wilt (Fusarium oxysporum f. sp. phaseoli). The three hybrid cultivars were put through a severe fusarium wilt screening at F_2 and F_3 generations in the field.

In El Salvador, cultivar PR-H-71-1-136 was infected with Rhizoctonia root rot (Rhizoctonia solani) and cultivar PR-H-71-1-R113 was attacked by web blight (Thanatephorus cucumeris).

No powdery mildew (Erysiphe polygoni) infection have been recorded on these cultivars either in Puerto Rico or in El Salvador.

Golden Yellow Mosaic. The white fly transmitted virus disease, golden yellow mosaic, is one of the most important diseases of beans in the lowland tropics. Cultivar PR-H-71-1-R101 has been susceptible to this virus both in Puerto Rico and in El Salvador. The other two cultivars have shown field tolerance.

The three cultivars are susceptible to Xanthomonas phaseoli and X. vignicola the causal organisms of common bacterial blight of beans and bacterial canker of cowpeas, respectively.

The three cultivars, though having black shiny beans and vine to semi-vine habit, possess a wide range of resistance and could be cultivated commercially where black beans are the preferred local staple. Also, these cultivars could be used as resistant parents for crosses with adaptable and commercially desired local varieties.

A limited amount of seed is available by writing to Dr. N.G. Vakili, Federal Experiment Station, P.O. Box 70, Mayaguez, Puerto Rico 00708.

Administrator
Agricultural Research Service

1/4/74
Date

ATTACHMENT 3

United States Department of Agriculture
Agricultural Research Service
Washington, D.C. 20250

NOTICE TO PLANT BREEDERS OF THE RELEASE OF FIVE COWPEA BREEDING LINES RESISTANT TO BACTERIAL BLIGHT OR CANKER

The Agricultural Research Service, United States Department of Agriculture announces the release of five cowpea (Vigna unguiculata (L.) Walp.) lines possessing a high degree of resistance to bacterial blight or canker (Xanthomonas vignicola Burkh.) in combination with resistance to other pathogens. These lines were also selected for adaptability to humid tropical conditions.

This project is supported in part by the Agency for International Development under a contract (PASA AJ 3-00) entitled "Regional Food Legume Improvement."

Bacterial blight of Southern pea is an endemic disease of tropical and subtropical regions. Fortunately, through centuries of selection by farmers, a large segment of the cowpea population has some degree of field tolerance, but this tolerance breaks down under periods of high humidity. Four of the five lines presented below are immune to bacterial blight. The bacterial blight resistant cultivar possessed other disease resistance characteristics.

Lines being released are:

1. Line designation: PR-V-70-4-R9.

Line PR-V-70-4-R9 was selected through repeated field screening of inoculated mature plants of PI 166146. Seedlings obtained from the final field selection were inoculated in the greenhouse. Inoculation was done by means of sand-blasting the stems and the leaves, and then spraying the bacterial suspension on the wounded tissues at 50 pounds per square inch. Seedlings which produced only whitish cankerous growth where wounded were selected as immune and then bulked.

Line PR-V-70-4-R9 is slightly susceptible to Puerto Rico Cowpea Mosaic virus which is similar to the Arkansas cowpea mosaic, moderately susceptible to Cercospora cruenta, resistant to C. canescens, and to Corynespora cassiicola, which is the causal organism of Target Spot, and moderately susceptible to Erysiphe polygoni.

Seeds of this selected lines are tan, small and semi-crowder. It is a low bush and does not defoliate, retaining green foliage after

pods are harvested.

2. Line designation: PR-V-70-4-R91.

Line PR-V-70-4-R91 was selected from PI 293472. It is resistant to all the pathogens mentioned above, except to E. polygoni, to which it has a highly susceptible response.

It has brown, small, semi-crowder seeds. The plant has a high bush habit and is mid-season maturing. This line has the most varied combination of resistance to diseases.

3. Line designation: PR-V-70-4-R95

Line PR-V-70-4-R95 was selected from PI 293521. It is immune to X. vignicola, resistant to C. cruenta, C. canescens, and C. cassiicola, but moderately susceptible to Puerto Rico cowpea mosaic virus and E. polygoni.

It has drab, small, semi-crowder seeds, and the plant is mid-season maturing with a semi-prostrate habit.

4. Line designation: PR-V-70-4-R105.

Line PR-V-70-4-R105 was selected from PI 293567. It has a resistant response to X. vignicola inoculation, resistant to C. cassiicola, and to C. canescens, but slightly susceptible to Puerto Rico cowpea mosaic virus, and moderately susceptible to C. cruenta and E. polygoni.

It has drab, small, semi-crowder seeds, mid-season maturing plants and a semi-prostrate habit.

5. Line designation: PR-V-70-4-R445.

Line PR-V-70-4-R445 was selected from PI 277784. It is immune to X. vignicola, resistant to Puerto Rico cowpea mosaic virus and C. cassiicola, moderately susceptible to E. polygoni and susceptible to C. cruenta and C. canescens.

The seeds are tan with brown speckle, medium size, and non-crowder. It is mid-season maturing, has a low bush habit, and yields well.

The resistance of PR-V-70-4-R91 and PR-V-70-4-R445 to Puerto Rico cowpea mosaic virus was field resistant of mature plants, while their seedlings showed slightly susceptible symptoms when inoculated in the greenhouse. These lines not only provide a high degree of resistance to bacterial canker as parents, but also contain resistance to a few other diseases. Line PR-V-70-4-R91 could be grown as a cultivar in regions where drab color Southern peas are preferred, such as Panama.

A limited amount of seed of each line is available. Request for seed should be sent to Dr. Nader G. Vakili at the Federal Experiment Station, P.O. Box 70, Mayaguez, Puerto Rico 00708.

Administrator
Agricultural Research Service

12/1/73
Date

ATTACHMENT 4

United States Department of Agriculture
Agricultural Research Service
Washington, D.C. 20250

NOTICE TO PLANT BREEDERS OF THE RELEASE OF FIVE COWPEA BREEDING LINES RESISTANT TO CERCOSPORA LEAF SPOT DISEASES

The Agricultural Research Service, United States Department of Agriculture, announces the release of five cowpea (Vigna unguiculata (L.) Walp.) lines possessing resistant to Cercospora leaf spot diseases.

This project is supported in part by the Agency of International Development under a contract (PASA AJ 3-00) entitled "Regional Food Legume Improvement."

During the hot and humid periods in spring or summer, Cercospora leaf spot caused defoliation of susceptible cultivars, at times, even before peas had become firm. This disease is caused by two Cercospora species, C. cruenta, and C. canescens. Infections of the former result in grayish lesions, while those of the latter are light brown. Generally, the PI accessions were either resistant or susceptible to both pathogens. But a few accessions showed differential response to infection by these two fungi. The resistant selections were obtained through three successive years of field screening. Field inoculation was done by spreading large quantities of infected leaves among the plants of the replicated trial during the summer rainy season. The five released lines are resistant to both pathogens.

Lines being released are:

Line designations: PR-V-70-4-R111, PR-V-70-4-R173, PR-V-70-4-R349, PR-V-70-4-R373, PR-V-70-4-R482. These lines were selected from the following PI accessions: 302457, 186459, 326157, 291140, and 319383, respectively.

Lines PR-V-70-R373 and PR-V-70-4-R482 were also resistant to Corynespora cassiicola, the causal agent of Target Spot, and slightly susceptible to Erysiphe polygoni. Line PR-V-70-4-R173 was the only one

in this group which was resistant to Xanthomonas vignicola. All were susceptible to Puerto Rico cowpea mosaic virus which is similar to Arkansas cowpea mosaic virus.

Line PR-V-70-4-R111 has small, non-crowder, tan seeds and a high bush habit; PR-V-70-R173 has very small, non-crowder, black-eye peas and a prostrate habit; PR-V-70-4-R349 has very small, non-crowder, brown-eye peas and a prostrate habit; PR-V-70-4-R373 small, semi-crowder, black seeds and a low bush habit; and PR-V-70-4-R48 has small, semi-crowder, purple-speckled seeds, and a low bush habit.

A limited amount of seeds of each line is available by writing to Dr. Nader G. Vakili, Federal Experiment Station, P.O. Box 70, Mayaguez, Puerto Rico 00708.

Administrator
Agricultural Research Service

12/7/73
Date

ATTACHMENT 5

United States Department of Agriculture
Agricultural Research Service
Washington, D.C. 20250

NOTICE TO PLANT BREEDERS OF THE RELEASE OF A LEAF SPOT RESISTANT YARD-LONG BEAN

The Agricultural Research Service, United States Department of Agriculture announces the release of a yard-long bean, Vigna unguiculata subsp. sesquipedalis (L.) Verdc., line which possesses a high degree of resistance to leaf spotting pathogens.

This project is supported in part by the Agency for International Development under a contract (PASA AJ 3-00) entitled "Regional Food Legume Improvement."

In the tropics the tender pods of the yard-long beans replace snap-beans (Phaseolus vulgaris) as green vegetables, and are a profitable cash crop when properly cultivated. The main diseases, in descending order of their importance, affecting this crop are Cowpea mosaic virus, Cercospora Leaf Spot and Powdery Mildew. Every yard-long plot observed in the survey of bean and Southern pea diseases, during 1971-1973, in the American tropics was infected with cowpea mosaic virus. Since most yard-long beans are cultivated during the rainy season, they were infected by one or both of the Cercospora species affecting this crop; and when cultivated during the dry weather, plants were severely attacked by powdery mildew. Few, if any, bacterial canker incidence was observed on this crop.

Line being released is:

Line Designation: PR-V-70-4-R268.

The yard-long line PR-V-70-4-R268 was obtained through successive line selections and screening of PI 269665 during 1970 to 1973. This line is resistant to Cercospora cruenta, C. canescens, Erysiphe polygoni, and to Corynespora cassiicola, the causal agent of Target Spot. It is susceptible to Puerto Rico cowpea mosaic virus which is similar to Arkansas cowpea mosaic virus, and to Xanthomonas vignicola.

This line has intermediate long pods, 50 to 60 cm., which are slim and delicate at the picking stage. Its seeds are red, long, and rice-shaped. It is early, flowering in 39 days, and bears a heavy pot set. Plants have indeterminate vine habit. The resistance to leaf spot permit its cultivation during the rainy season when Chrysomelids, the vectors transmitting cowpea mosaic virus, are not plentiful. A few insecticide applications should make the crop almost disease free. Also, since it contains leaf spot resistance, it is easier to incorporate cowpea mosaic virus resistance and other desired agronomic features into its genotype.

Limited amounts of seed of this line are available by writing to Dr. Nader G. Vakili, Federal Experiment Station, Mayaguez, Puerto Rico 00708.

Administrator
Agricultural Research Service

Date