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University of Puerto Rico
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PARTMENT OF PLANT PATHOLOGY AND BOTANY
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Río Piedras, Puerto Rico

SUBSTANTIVE PROGRESS REPORT OF RESEARCH PROJECT No. 931-17-130-562 (CONTRACT NO. AID/CM/ta-C-73-26), IMPROVEMENT OF TROPICAL PRODUCTION OF BEANS AND COWPEAS THROUGH DISEASE AND INSECT CONTROL

PERIOD COVERED: 14 May - 31 December 1973

OTHER INSTITUTIONAL UNITS INVOLVED AND COOPERATING AGENCIES: Department of Entomology, Isabela Substation, Federal Experiment Station (Pulse Group), Boyce Thompson Institute

SCIENTIFIC PERSONNEL PARTICIPATING: Julio H. López-Rosa (Leader), Julio Bird (Phytovirologist), J. Enrique Pérez (Phytovirologist and Bacteriologist), Pedro L. Meléndez (Phytopathologist), Jessé Román (Nematologist), Carlos Cruz (Entomologist), Josefina Sánchez del Moral (Assistant Biologist), Rita L. Rodríguez (Research Assistant), Amelia C. Monllor (Assistant Bacteriologist) and Gerardo Mangual (Research Assistant)

PROJECT OBJECTIVE:

To investigate and develop methods of control of limiting diseases of selected food legumes adapted to the tropics, particularly beans and cowpeas.

The Progress Report on the above Research Project is submitted in the following pages.

Project Leader Julio H. López-Rosa (Typed Name) Julio H. López Rosa (Signature)

Head of Department Julio H. López-Rosa (Typed Name) Julio H. López Rosa (Signature)

DATE 15 February 1974

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SUMMARY

VIRUS DISEASES OF BEANS

A new strain of cucumber mosaic virus was isolated from beans and characterized using symptomatology, host range, physical properties and serological relationships as criteria. The results of host range and cross-protection studies indicate that the Jacquemontia pentantha and Ipomoea quinquefolia viruses are not related. Two rugaceous "viruses" (Rhynchosia and golden yellow) were transmitted by mechanical means using adjuvants (Na_2HPO_4 + NaDIECA + activated charcoal). Some vector-virus relations of these two "viruses" were amply studied. Both are persistent and easily acquired and efficiently transmitted by male and female whiteflies (Bemisia tabaci). Clitoria laurifolia was found to harbor, in nature, the Rhynchosia mosaic virus. A seemingly new mosaic virus has been isolated from Crotalaria striata. The virus has a wide host range and affects beans and cowpeas.

VIRUS DISEASES OF COWPEAS

Four seemingly different strains of cowpea mosaic virus have been found in the Island. They differ in their host range from the original Puerto Rico cowpea mosaic virus. Serologically they cannot be distinguished from the original isolate.

FUNGUS AND BACTERIAL DISEASES OF BEANS AND COWPEAS

The fungicides Kocide 101, Copper 53, Dithane M-45, Daconil and Benlate are being tested for their effectiveness in controlling the following diseases of cowpea and beans: Common bacterial blight (Xanthomonas phaseoli), leaf spots (Corynespora cassiicola and Cercospora spp.), powdery mildew (Erysiphe polygoni) and rust (Uromyces phaseoli var. typica). The fungicides are being applied at various rates, some on a weekly and others on a biweekly basis.

SURVEY OF NEMATODES ASSOCIATED WITH BEANS AND COWPEAS

A survey of the nematodes associated with beans, cowpeas and other related legumes is in porgress. Thirteen different soybean varieties were sampled. The plant-parasitic or suspected plant-parasitic genera Pratylenchus, Helicotylenchus, Meloidogyne, Trophurus, Rotylenchulus, Seinura, Aphelenchus, Aphelenchoides and Tylenchus were found to be associated with these varieties. The free-living forms associated with soybeans were Dorylaimus, Rhabditis, Cephalobus, Crusnema, Mononchus, Iotonchus, Pelodera, Diploscapter, Desmolaimus, Prismatolaimus, Cromadora and Belondira. Pratylenchus, a world-known parasite of leguminous crops, was found in all varieties, except Tainung and Americana. Helicotylenchus was not found in varieties Jupiter and Mandarin. Meloidogyne was found only in Wakashima; Rotylenchus in Biloxi; and Trophurus in Hardee.

INSECTS OF BEANS AND COWPEAS

Field tests were initiated with beans and cowpeas to evaluate registered and new promising insecticides on the control of the most important insects of these crops. Twenty-one varieties of beans and cowpeas were planted to observe their reaction to destructive insects.

IMPORTANCE OF WORK IN PROGRESS

VIRUS DISEASES OF BEANS

The present work is directed to locate, identify, determine the range of, and characterize legume viruses with particular emphasis on rugaceous (white-fly transmitted) ones. These studies will enable us to gauge the potential of legume viruses as inciters of bean diseases. The above studies will also allow us to test germ plasm for resistance to specific viruses and also provide adequate conventional control means.

VIRUS DISEASES OF COWPEAS

It has been established that viruses affecting cowpea (Vigna unguiculata Walp.) cause great losses in yield. The procurement of resistant cowpea cultivars would insure planters from sustaining the great losses caused by virus diseases.

FUNGUS AND BACTERIAL DISEASES OF BEANS AND COWPEAS

In Puerto Rico, and presumably in other areas of the humid American tropics, legumes are subject to attack by devastating foliar pathogens. During periods of heavy rains and high temperatures total defoliation of plantings is to be expected if measures are not employed to protect them from these diseases. Common bacterial blight (Xanthomonas phaseoli), rust of beans (Uromyces phaseoli var. typica), and leaf spots of cowpea (Corynespora cassiicola, Cercospora spp.) are among the most serious diseases for which control measures must be secured. Thus, a program was initiated last September to test the effectiveness of standard, as well as newly developed fungicides and bactericides in controlling these diseases under field conditions.

SURVEY OF NEMATODES ASSOCIATED WITH BEANS AND COWPEAS

Beans and cowpeas and other related legumes are important sources of food throughout the world. Low yields are a problem, especially in these days of worldwide food shortages. There are many factors which may be associated with this yield decline complex in the tropics. Nematodes are possibly an important part of this complex, but little research has been conducted to clearly define the relative role of the various factors. There is urgent need to identify the nematode fauna associated with beans, cowpeas and other related legumes, investigate their role in the yield decline complex and devise means of control.

INSECTS OF BEANS AND COWPEAS

Little information is available concerning insect pests of leguminous crops in the tropics. The Agricultural Experiment Station of the University of Puerto Rico has been conducting trials for chemical control of the bean leafminer. However, the results have been erratic and consequently there is not a good control recommendation available. The bean leafminer, Lyriomisa munda, was identified and reared during 1972. At the same time, two parasites of the leafminer were identified on beans and cucumbers. In addition, studies have been conducted on the general biology and damage caused by bean leafhoppers and by insects in the pod-borer complex. Investigations on bean and cowpea insects have been performed also in the United States and other countries. Some of these investigations have been related to resistance of these crops to their insect pests. The need to increase food production for the increasing world population makes it necessary to conduct research to identify the most important insect problems, to evaluate germ plasm for resistance to insects, and to determine the most effective insecticides and minimum dosages that will control the major pests of beans and cowpeas.

It is expected that a detailed study of varietal resistance and the determination of the minimum dosages of effective insecticides will lead to a more rational use of chemicals. This will be reflected in increased food production. Resistant material, even if inferior in yield or in protein content, will serve as breeding material.

DESCRIPTION OF EXPERIMENTAL WORK CONDUCTED

VIRUS DISEASES OF BEANS

The characterization of a new bean strain of cucumber mosaic virus (CMV) was effected using such criteria as host range, indicators, serology, physical properties and vector specifity. The virus under study often became inactive under greenhouse (standard) conditions due to the high ambient temperatures (115°F at times) and the extreme heat lability of the agent. Air-water cooled mini-greenhouses proved to be excellent for counteracting the stated problem.

Cross-protection studies with viruses of Jacquemontia pentantha and Ipomoea quinquefolia were made employing tobacco plants of variety Virginia 12. The plants were infected using scion grafts from plants previously inoculated via the common vector, Bemisia tabaci race sidae. Mechanical transmission of the golden yellow mosaic and the Rhynchosia mosaic viruses of beans was achieved in the greenhouse at high ambient temperatures during the late summer months (temperatures up to 100°F during noon). Similar results were obtained when the test plants were maintained in air-water cooled mini-greenhouses. When using adjuvants such as activated charcoal it is important (for best results) to wash off the black film left after inoculation. If the film is not removed the primary site of the inoculation will absorb heat and the disease agent will fail, in many cases, to infect.

Screening of soybean varieties for resistance to the Rhynchosia virus was carried out in the insectary using large whitefly populations maintained on Rhynchosia minima.

Electron microscopy studies of bean tissues affected by the Rhynchosia and the golden yellow mosaic diseases were performed by Maramorosch and Hirumi at the Boyce Thompson Institute. No disease agents could be detected in the studied tissues.

VIRUS DISEASES OF COWPEAS

A survey of cowpea viruses in Puerto Rico is being conducted with the purpose of studying the viruses that affect the crop and testing for resistance introductions from other countries.

FUNGUS AND BACTERIAL DISEASES OF BEANS AND COWPEAS

FIELD WORK

Four experiments are in progress at the Isabela Substation. The first one was established to test the effectiveness of Kocide 101, Copper 53, Daconil (Bravo) and Benlate in controlling common bacterial blight of beans caused by Xanthomonas phaseoli. Fungicidal concentrations being used in this test are as follows: Daconil and Copper 53, 1 and 2 pounds per 100 gallons of water; Kocide 101, 1/2 and 1 pound per 100 gallons of water; and Benlate, 1/4 and 1/2 pound per 100 gallons of water. The experimental area is 0.35 acres. The layout corresponds to a partially balanced incomplete block design, and includes 9 treatments, each replicated 6 times. The bean cultivar being tested is the highly susceptible R-19.

The second experiment was designed to test 3 fungicides for control of leaf spot of cowpea caused by Corynespora cassiicola. Each chemical was employed at 3 concentrations as follows: Daconil and Dithane M-45 at 1, 2 and 4 pounds per 100 gallons of water and Benlate at 1/4, 1/2 and 1 pound per 100

gallons of water. The experiment covers an area of 0.35 acres with a pair plot design. Ten treatments are included, each replicated 5 times. The cowpea cultivar tested is Early Ramshorn, which is highly susceptible to the disease under study.

The third experiment was designed to test the effectiveness of Daconil, Dithane M-45 and Benlate in controlling leaf spot of cowpea caused by Cercospora spp. Materials and methods employed for this experiment are essentially the same as those used for experiment number 2.

Land for the fourth experiment is being prepared. Four fungicides will be tested against bean leaf rust caused by the fungus Uromyces phaseoli var. typica. The fungicides to be tested are Plantvax, Vitavax, Triforine, and Daconil. Rates of application and the experimental design to be used will appear in the next report.

LABORATORY WORK

Cooperation was given on the identification of bacteria pathogenic to beans and cowpeas to Drs. N. G. Vakili and W. J. Kaiser from the Federal Experiment Station at Mayaguez. Forty-seven different bacteriological tests for classification of bacterial isolates were conducted. Serological tests were performed also when antisera were available.

SURVEY OF NEMATODES ASSOCIATED WITH BEANS AND COWPEAS

In an attempt to identify the nematodes associated with beans, cowpeas and other related legumes, samples of roots and soil were taken from a planting at the Corozal Substation. This field had been planted to soybeans for about 5 consecutive years. Although emphasis is to be placed on beans and cowpeas, it was thought desirable to take advantage of this opportunity to investigate the nematodes associated with this crop.

Soil and root samples (250 cc of soil and 5 grams of roots) were taken and processed in the laboratory following the usual procedures for separating nematodes from roots and soil and for the identification of the species.

INSECTS OF BEANS AND COWPEAS

On October, 1973 two plantings were made, one with cowpeas (var. Gold Coast) and one with white beans (var. No. 1) to determine the effectiveness of different insecticides on the control of the most important insects of these crops (leaf-miners, beetles, cutworms, etc.). Eight different insecticide treatments of registered and new promising materials will be tested and compared with an untreated control. Plots consist of two 20-feet long rows arranged in a completely randomized block design with 4 replications. Observations will be made periodically to record the most important insects and to determine when treatments should be applied.

Plots of 6 varieties of cowpeas and 15 varieties of beans were planted on the same date to observe differences on susceptibility to destructive insects.

RESULTS, INTERPRETATION OF FINDINGS AND PRESENT OUTLOOK

VIRUS DISEASES OF BEANS

A new strain of CMV was isolated from field beans affected by a mild mosaic. The host range of the causal agent is very similar to that of Wellman's CMV. The new strain is extremely heat labile (45-50°C), cannot stand dilutions of more than 10^{-1} and is serologically related to known CMV strains.

The results of host range and cross-protection studies indicate that the Jacquemontia pentantha and Ipomoea quinquefolia viruses are not closely related. These two viruses cause deforming diseases of beans and are propagated by the Sida race of the whitefly Bemisia tabaci. Lack of adequate insect-proof insectaries and greenhouses have limited us in our endeavors to properly characterize the referred to agents.

The golden yellow and the Rhynchosia mosaic viruses of beans, transmitted in nature by the Sida race of the whitefly B. tabaci, were successfully inoculated by mechanical means using Na_2HPO_4 buffer, NaDIECA and activated charcoal as adjuvants. Up to 17 percent infection was obtained in the particular case of the Rhynchosia virus. This percent infection was obtained when the inoculum was secured from young tender leaves of infected tobacco plants. Lower percent infection resulted when the inoculum was extracted from the primary host of the Rhynchosia virus. The early phase of this work was carried out in cooperation with a visiting scientist from France, Dr. Hervé Lot. No resistance to the Rhynchosia mosaic virus was found among 36 soybean varieties tested in the greenhouse. The plants were inoculated via the whitefly B. tabaci. Some of the vector-virus relations of the Rhynchosia and golden yellow mosaic viruses of beans were amply studied. Both viruses are, definitely, persistent and not transmitted transovarially.

A mycoplasma-like organism was found to occur in mixed infection with a rhabdovirus on Cajanus indicus plants affected by a witches broom disease (cooperative work). This malady is similar to one detected in Santo Domingo and seemingly provoked by the same agents. No viruses have been found to occur in

association with the Rhynchosia and golden yellow mosaic diseases of beans. These two maladies propagated by the same whitefly species have been presumed to be caused by viral agents. The possibility exists that the causal agent is not a virus.

Attempts made to transmit the mosaic virus of Desmodium canum by mechanical means using undiluted, diluted and treated saps (Na_2HPO_4 + NaDIECA + activated charcoal) were unsuccessful. However, the virus was inoculated with relative ease via Aphis craccivora, an aphid normally found on legumes in Puerto Rico. Both D. canum as well as Cassia (Ditrémexa) occidentalis were infected using viruliferous aphids. The virus seems to be of the non-persistent type. The D. canum virus does not affect beans or cowpeas.

Vivid golden yellow mosaic symptoms were detected on Clitoria laurifolia in the Tortuguero area. The causal agent of this mosaic was transmitted from Clitoria to beans through the whitefly B. tabaci. Symptoms obtained on beans are indistinguishable from those incited by the Rhynchosia mosaic virus.

A seemingly new mosaic virus (at least in Puerto Rico) has been isolated from Crotalaria striata. The symptoms elicited by this virus on the stated host are the following: Restriction of leaf lamina, yellow-green mosaic, oak-leaf pattern mosaic, vein banding, puckering, blistering, etc. The Crotalaria virus causes a mottling, leaf-deforming disease of beans and induces localized lesions on Solanum torvum, Gomphrena globosa and Chenopodium quinoa. The growing point of Phaseolus lunatus plants affected by this mosaic virus develop acronecrosis several days after inoculation. The Crotalaria virus incites the formation of ringspots on tobacco and S. torvum.

The host range of the "new" Crotalaria striata mosaic virus is being determined (mechanical inoculation) using untreated sap expressed from affected leaves. The virus seems to have a very wide host range and could be one of the strains of tobacco ringspot virus. Identification (preliminary) via serological means is being attempted using precipitin and gel diffusion methods.

Dr. Roger Lawson (USDA) has taken some of our infected material to his laboratory for electron microscopy. The following viruses were relinquished to him for the stated purpose: Ipomoea quinquefolia, Rhynchosia minima, VPI, BGYM, and Jacquemontia pentantha. Dr. Lawson also received from us freeze and calcium chloride dried tobacco leaf samples containing active CMV (Río Piedras strain capable of infecting beans) for comparative studies.

VIRUS DISEASES OF COWPEAS

As stated earlier, a survey of cowpea viruses from Puerto Rico has been started. To date, ten different localities have been surveyed. Four isolates of cowpea mosaic have been recovered. All isolates showed mild mosaic and sometimes blistering of the small leaves in the field. Two isolates were obtained at Sabana Grande (SG_1 and SG_2), SG_1 from a local red seeded cultivar and SG_2 from a small blackeye cultivar. The other two isolates were obtained at Camuy and at Las Piedras from cream colored seeded cultivars.

Upon inoculation of cowpea cultivars Black and Blackeye Early Ramshorn the symptoms induced by all four isolates were very similar to those induced by the Puerto Rico cowpea mosaic virus (PRCMV) already studied and described in 1968-70. The symptoms in the Black cultivar consisted of necrotic rings, veinal necrosis, epinasty of primary leaves, severe systemic mottle and wrinkless of trifoliates. Infected plants eventually died. In the Blackeye cultivar the symptoms were confluent chlorotic spots on the primary leaves and generalized systemic mosaic with blistering and distortion of the trifoliate leaves.

The various isolates recently acquired are now being increased for characterization studies and for screening cowpea selections for resistance. Preliminary results are summarized in tables 1-3 (pages 12a-12c). All hosts which reacted negatively to the Camuy isolate, as shown in table 1, became infected with the original isolate of PRCMV obtained in 1967.

Some physical properties of the SG_2 isolate were determined. The virus in crude sap, heated in individual Wasserman tubes from 50-70°C (at 5° intervals), was inactivated at 65-70°C. The dilution endpoint of the virus in crude sap (diluted in cold water) was 1×10^{-6}.

Sap from leaves of Blackeye cowpea separately inoculated with the four isolates was extracted by grinding in sterile mortars and centrifuging at 3,000 r.p.m. The clarified saps were then tested against a constant concentration (dilution of 1/40 in saline) of PRCMV antiserum and antisera at the same concentration to Puerto Rican pepper mosaic virus, cowpea chlorotic mottle and tobacco mosaic virus. All four isolates reacted only with PRCMV.

FUNGUS AND BACTERIAL DISEASES OF BEANS AND COWPEAS

FIELD WORK

All the experiments are still in progress. Data to be collected will be included in the next report.

LABORATORY WORK

The following isolates and type cultures were sent to us by Drs. N. G. Vakili and W. J. Kaiser from Mayaguez. Physiological reactions, as well as morphology, staining, ability to split carbohydrates, etc. were used in their identification.

Isolate	Classification
Isolate nos. 113, 253 and 257	*Xanthomonas phaseoli*
Isolate no. 200	*Xanthomonas phaseoli* var. *fuscans*
Isolate no. 303, type culture from ATCC	*Xanthomonas phaseoli*
Isolate no. 304, type culture from ATCC	*Xanthomonas phaseoli* var. *fuscans*

Table 1.-Reactions of certain plant species and cultivars to inoculation with the Camuy virus isolate obtained from cowpea

Host	Reaction
Cowpea var. Clay	Confluent greenish to chlorotic spots on primary leaves
Phaseolus vulgaris (cv. Stringless Black Valentine	Epinasty of primary leaves; mosaic of trifoliates
P. vulgaris cv. US#5 Refugee	No symptoms
P. vulgaris cv. Stringless Green Refugee	"
P. vulgaris cv. Rosita	"
P. vulgaris cv. Dominicana	"
P. vulgaris cv. Blanca	"
P. vulgaris cv. Criolla	"
Chenopodium amaranticolor	"
C. quinoa	"
C. album	"
Capsicum frutescens var. Large Bell Hot	"
Datura metel	"

Table 2.-Reaction of pigeon pea selections and varieties to inoculation with the SG_2 virus isolate obtained from cowpea[1/]

Selection	Reaction of plants 7 days after inoculation	
645B3	3/9[2/]	Yellow spots, necrosis on trifoliates
Florido	11/17	"
Line 7	13/19	"
64-7B Link	11/12	"
Khaki	10/16	"

1/ Fresh crude sap inoculated onto leaves of small (6 leaved) pigeon pea.

2/ Numerator denotes number of plants showing symptoms; denominator denotes number of plants inoculated.

Table 3.-Reaction of cowpea selections[1/] to inoculation with the SG_2 virus isolate obtained from cowpea

Selection	Reaction of plants 20 days after inoculation		
Unknown	21/24[2/]	+ [3/]	Susceptible[5/]
4R9	22/24	+	"
4R95	17/18	+	
4R256	0/25	- [4/]	Resistant
4R111	14/22	+	Susceptible
4R445	22/25	+	"
4R203	19/24	+	"
4R105	9/13	+	"

1/ Cowpea selections furnished by Dr. Nader Vakili, Federal Experiment Station, Mayaguez.

2/ Numerator denotes number of plants showing symptoms; denominator denotes number of plants inoculated.

3/ + = Symptoms on primary and/or trifoliate leaves.

4/ - = No symptoms

5/ Susceptible plants are those recorded as developing symptoms on primary and/or trifoliate leaves.

Pending classification and/or confirmation:

Isolate no. 212 - pathogenic to beans and cowpeas

Isolate no. 319 - type culture Xanthomonas vignicola (ATCC no. 11648)

Isolate no. 361 - cream colored bacterium isolated from lesions on bean leaves

Isolate no. 362 - bacterium yielding yellow colonies pathogenic to bean

SURVEY OF NEMATODES ASSOCIATED WITH BEANS AND COWPEAS

Table 4 (pages 13a-13c) presents the nematodes found in association with the different soybean varieties. As it can be observed, a great variety of species were found in the roots or in the soil around the root system. Of these nematodes the most important plant-parasitic forms are Pratylenchus and Helicotylenchus. Pratylenchus is known universally as a parasite of leguminous crops. Pratylenchus was associated with all varieties, except Tainung and Americana; Helicotylenchus was associated with all, except Jupiter and Mandarin. Three other important plant-parasitic forms were: Meloidogyne (in Wakashima), Rotylenchulus reniformis (in Biloxi) and Trophurus (in Hardee).

It is not known, whether any of these varieties has some form of resistance to any of the nematode species found. Additional information is needed to clarify this matter.

INSECTS OF BEANS AND COWPEAS

No results are available yet.

Table 4 - Nematodes associated with different varieties of soybean

Soybean variety	Nematodes Soil (250 cc)	Nematodes Roots (5 gm.)
Sankou	Pratylenchus* P. scribneri* Tylenchus* Dorylaimus Rhabditis	Helicotylenchus* Seinura* Pratylenchus scribneri* Tylenchus* Dorylaimus Rhabditis Cephalobus
Tainung	Helicotylenchus* Tylenchus* Dorylaimus Cephalobus Crusnema	Tylenchus* Helicotylenchus* H. dihystera* Aphelenchus* Cephalobus Dorylaimus Rhabditis
Wakashima	Helicotylenchus* H. dihystera* Pratylenchus* Aphelenchus* Cephalobus Dorylaimus Mononchus	Meloidogyne* Aphelenchus* Tylenchus* Dorylaimus Rhabditis
CNS	Tylenchus* Aphelenchus* Helicotylenchus* H. dihystera* Seinura* Dorylaimus Crusnema Mononchus Belondira Iotonchus Cephalobus	Pratylenchus scribneri* Tylenchus* Dorylaimus Mononchus
Hardee	Pratylenchus zeae* P. Scribneri* Helicotylenchus* H. dihystera* Tylenchus* Trophurus* Mononchus Cephalobus Dorylaimus Crusnema	Aphelenchus* Aphelenchoides* Helicotylenchus* Pratylenchus* Dorylaimus Rhabditis Crusnema

Biloxi	Rotylenchulus reniformis*	Tylenchus*
	Tylenchus*	Aphelenchoides*
	Pratylenchus zeae*	Aphelenchus*
	Aphelenchus*	Rhabditis
	Aphelenchoides*	Pelodera
	Helicotylenchus*	
	Helicotylenchus*	
	H. caribensis*	
	H. dihystera*	
	Seinura*	
	Dorylaimus	
	Cephalobus	
	Diploscapter	
	Rhabditis	
Palmeto	Aphelenchus*	Tylenchus*
	Pratylenchus zeae*	Pratylenchus*
	Helicotylenchus*	P. zeae*
	Cephalobus	Aphelenchus*
	Rhabditis	Seinura*
	Dorylaimus	Cephalobus
	Desmolaimus	Rhabditis
NTV-Kao Suing	Helicotylenchus*	Aphelenchoides*
	H. dihystera*	Pratylenchus brachyurus*
	Pratylenchus zeae*	Pratylenchus scribneri*
	Crusnema	Belondira
	Cephalobus	Dorylaimus
	Desmolaimus	Rhabditis
	Mononchus	
	Iotonchus	
	Dorylaimus	
	Belondira	
Jupiter	Dorylaimus	Pratylenchus*
	Cephalobus	P. zeae*
	Rhabditis	Tylenchus*
	Desmolaimus	Rhabditis
		Cephalobus
		Crusnema
		Dorylaimus
Mandarin (tipo #2 Colombia)	Tylenchus*	Pratylenchus*
	Pratylenchus*	P. brachyurus*
	Dorylaimus	Aphelenchoides*
	Cephalobus	Cephalobus
		Dorylaimus

Table 4 (Cont.)

ICA-Lili (Colombia)	Aphelenchoides Pratylenchus* P. zeae* P. scribneri* Helicotylenchus* Iotonchus Cephalobus Dorylaimus Rhabditis Cromadoridae Prismatolaimus	Helicotylenchus* H. dihystera* Laimaphelenchus Aphelenchoides Cephalobus Pelodera Metadiplogaster Prismatolaimus Dorylaimus
Pelicano SM-ICA (Colombia)	Tylenchus* Aphelenchoides* Helicotylenchus* Pratylenchus zeae* Cephalobus Rhabditis Cromadora	Aphelenchoides* Helicotylenchus* Rhabditis
Americana (Ecuador)	Helicotylenchus* Tylenchus* Dorylaimus Cephalobus Rhabditis	Tylenchus* Cephalobus Crusnema Mononchus

*Plant-parasitic or suspected plant-parasitic nematodes.

PUBLICATIONS

1. Bird, J. and J. H. López-Rosa, New whitefly and aphid-borne viruses of bean (Phaseolus vulgaris) in Puerto Rico. (Abstract) Grain Legume Improvement Workshop, Ibadan, Nigeria, 29 October - 2 November 1973.

2. Bird, J., J. Sánchez, R. L. Rodríguez, and A. Cortés-Monllor, A mosaic of beans (Phaseolus vulgaris L.) caused by a strain of common cucumber mosaic virus. J. Agr. Univ. P.R. (In press).

3. Bird, J., J. Sánchez, and N. G. Vakili, Golden yellow mosaic of beans (Phaseolus vulgaris) in Puerto Rico. Phytopathology (Abstr.) 63(12): 1435, 1973.

4. Hirumi, H., M. Kimura, K. Maramorosch, J. Bird, and R. Woodbury, Rickettsia-like organisms (RLO) in the phloem of little leaf diseased Sida cordifolia. Paper presented at Second International Congress of Plant Pathology, Minneapolis, Minn., 1973.

5. Maramorosch, K., H. Hirumi, M. Kimura, J. Bird, and N. G. Vakili, Pigeon pea witches' broom disease. Paper presented at Second International Congress of Plant Pathology, Minneapolis, Minn., 1973.

TRAVEL

Dr. Pedro L. Meléndez surveyed, along with Dr. Walter J. Kaiser, bean diseases in the highlands of Haiti from 21-29 June.

Drs. Pedro L. Meléndez and Julio H. López-Rosa attended the Second International Congress of Plant Pathology held in Minneapolis, Minn. from 5-12 September.

Dr. Jessé Román attended the Annual Meeting of the Organization of Tropical American Nematologists held in Maracay, Venezuela from 1-6 October.

Dr. Julio H. López-Rosa attended the Grain Legume Improvement Workshop held at the International Institute of Tropical Agriculture at Ibadan, Nigeria from 28 October - 2 November.

Dr. Carlos Cruz attended the Annual Meeting of the Entomological Society of America held in Dallas, Texas from 25 November - 1 December.

Dr. Pedro L. Meléndez attended the Annual Meeting of American Phytopathological Society, Caribbean Division, held in San José, Costa Rica from 9-14 December.

APPENDIX

Studies with *Phaseolus lathyroides* virus

At the start of this project attempts were made to isolate viruses from both wild and cultivated leguminous hosts. A mosaic virus was isolated from *Phaseolus lathyroides*, a wild legume. This agent was inoculated onto the leaves or cotyledons of 58 different plant species and/or varieties by rubbing infective tobacco sap after dusting with carborundum. The virus was found to infect Samsun NN-tobacco, cucumber, *Chenopodium amaranticolor*, *C. quinoa* and other non-leguminous hosts. The virus induced the formation of local lesions on *C. quinoa* leaves.

The symptoms in Samsun NN-tobacco were mosaic with an oak-leaf pattern expression. Tobacco sap was used as inoculum for other plants. After dusting the leaves with carborundum, the sap was inoculated on the following hosts and reactions recorded. The following *Leguminosae* were inoculated: *Phaseolus coccineus*, mild mosaic of trifoliates; *P. lunatus* cv. Sieva, vein yellowing of trifoliates; *Crotalaria striata*, veinbanding mosaic of the younger leaves; *P. vulgaris* cv. Bountiful, mild mosaic of trifoliates; *P. vulgaris* cv. Improved Tendergreen, blistering and vein clearing of trifoliate leaves; and *P. vulgaris* cv. R-19, veinbanding mosaic. Forty-seven other species and/or varieties of plants inoculated did not show symptoms. These are listed in the following pages. The virus had a dilution endpoint of 1:1000 when tested on *C. quinoa*. It was inactivated at a temperature between 65-70°C. It did not withstand freezing for 24 hours. Infective sap from NN-type tobacco leaves was used in gel diffusion tests against three antisera to widely different strains of cucumber mosaic and found to react positively. The antisera used had been prepared by Drs. H. A. Scott and R. J. Shepherd from the United States and Dr. D. Z. Maat from the Netherlands. Healthy sap and normal serum were used as controls.

APPENDIX

List of plants that reacted negatively (no symptoms induced) to inoculation with *Phaseolus lathyroides* mosaic virus

1. *Antirrhinum majus* L. (snapdragon)
2. *Beta vulgaris* L. var. Ruby Queen (sugarbeet)
3. *Brassica campestris* var. Golden Bell (turnip)
4. *Brassica oleraceae* var. Golden Acre (cabbage)
5. *Canavalia ensiforme* L.
6. *Capsicum frutescens* cv. Large Bell Hot
7. *Capsicum frutescens* cv. Tabasco
8. *Cassia occidentalis* (senna)
9. *Chrysanthemum morifolium* (chrysanthemum)
10. *Citrullus vulgaris* Schrad cv. Charleston Gray (watermelon)
11. *Cucumis melo* cv. Hale's Best (muskmelon)
12. *Cucurbita pepo* cv. Small Sugar
13. *Cucurbita pepo* var. melopepo Alef cv. Early Golden Summer Crookneck (squash)
14. *Dahlia pinnata* L. (dahlia)
15. *Datura metel* L.
16. *Datura stramonium* (Jimson weed)
17. *Dolichos lablab* (hyacinth bean)
18. *Glycine max* cv. Kanrich (soybean)
19. *Gomphrena globosa* (Bachelor's button)
20. *Helianthus annus* (sunflower)
21. *Ipomoea learii* Paxton (morning glory)
22. *Lathyrus latifolius* (perennial sweet pea)

23. Lycopersicum esculentum Mill cv. Manalucie (tomato)
24. Medicago sativa var. Caliverde (alfalfa)
25. Phaseolus aborigeneus
26. Phaseolus acutifolius
27. Phaseolus acutifolius var. latifolius
28. Phaseolus angularis
29. Phaseolus aborigeneus
30. Phaseolus aureus
31. Phaseolus calcaratus
32. Phaseolus mungo
33. Phaseolus ricardianus
34. Phaseolus lunatus cv. Fordhook
35. Phaseolus lunatus
36. Phaseolus vulgaris cv. Kentucky Wonder (French bean)
37. Phaseolus vulgaris cv. U.S.#5 Refugee
38. Pisum sativum var. Little Marvel (pea)
39. Pisum sativum cv. Wando
40. Raphanus sativus cv. Long Black Spanish (radish)
41. Sesbaina exalta
42. Solanum melongena cv. Black Beauty (eggplant)
43. Sorghum vulgare (sorghum)
44. Vigna unguiculata L. (Walp) cv. Black
45. Vigna unguiculata L. (Walp) cv. Blackeye
46. Vinca rosea L. (periwinkle)
47. Zinnia elegans L. (zinnia)