ABSTRACTS OF PAPERS

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ABSTRACTS

A FIELD TRANSFERABLE PRECISION SPRAY TECHNIQUE FOR EVALUATING FUNGICIDE EFFICACY USING ASCOSPORES OF BLACK SIGATOKA. (Mycosphaerella fijiensis var. difformis). J. Cruz, R. H. Fulton, L. T. Palmer, Div. of Tropical Research, Tela Railroad Co., La Lima, Honduras.

Spray settling towers have been employed to evaluate oils and fungicide formulations for control efficacy on banana leaves in situ. Since the major spray target were ascospores, the tower technique was modified to actually determine the fungicide efficacy on these propagules. Following low volume application to slides, moistened ascocarp leaf tissue was suspended 25 cm. above the treated surface. Thirty minutes were sufficient for ascospore discharge and impaction; this was followed by a 48 hr incubation period for germination studies. A new mancozeb flowable formulation was employed as the test candidate. A concentration range of 0.25 to 4.2 l/ha. was applied in 18.7 l/ha. of water. Zero ascospore germination was verified within the 2.72 to 3.46 l/ha. range. This data transfer to aerial application trials confirmed Black Sigatoka control employing similar dosages as based on seasonal disease pressure.

THE INFLUENCE OF *PRATYLENCHUS ZEAE* INOCULATION LEVELS ON MAIZE GROWTH AND YIELD. J. A. Cuarezma-Terán, A. Ayala, A. Sotomayor Ríos, and P. R. Hepperly. Dept. of Crop Protection, Univ. of P.R., Mayaguez, and MITA, USDA, Mayaguez, Puerto Rico 00708

Hybrid maize, Pioneer 'X304C' plants were grown in sterilized soil in 30 cm clay pots in a greenhouse at 30°C. Plants were inoculated with 0, 100, 200, 400, 800, 1600 and 3200 larvae of *Pratylenchus zeae* Graham. Inoculation with 1,600 or 3,200 larvae significantly ($P = 0.05$) reduced plant height compared to the other treatments. The lowest inoculation level (100) reduced both green and dry weight of plants. Green and dry weight reductions increased with increasing inoculum levels. Results suggest that low populations of *P. zeae* can reduce maize yield without obvious stunting, whereas, high levels can cause marked stunting and increased yield losses.

MEXICO 309 AS A SOURCE OF RESISTANCE TO BEAN RUST. R. Echávez, G. F. Freytag, and Mildred Zapata, Dept. of Crop Protection, Univ. of P.R. & MITA/USDA/SEA-AR, Mayaguez, Puerto Rico 00708.

The black bean cultivars B-190 and 2B-5-1, are immune and highly resistant, respectively, to bean rust (*Uromyces appendiculatus*) in Puerto Rico. Their rust resistance is derived from Mexico 309 which has been identified as highly resistant to rust here and in other countries. B-190 was developed from a single plant selection in F_2 from Mex. 309 x 50600; and 2B-5-1, similarly, from a double cross using La Vega x 15R-55 (female), and Mex. 309 x La Vega (male). Rust resistance from Mex. 309 was combined with resistance to viruses and high yield from other parents. The influence of maternal cytoplasm on the inheritance of rust resistance was demonstrated by the segregation ratios in the F_2 generation from reciprocal crosses and indicates the importance of using the rust resistance source as the maternal parent. Supported in part by USAID/UPR Contract AID/ta-c-1296.

CHARACTERIZATION OF SORGHUM SEEDBORNE MYCOFLORA AND ITS EFFECT ON 30 SORGHUM LINES UNDER HUMID TROPICAL CONDITIONS IN PUERTO RICO. C. Feliciano*, P. Hepperly*, and A. Sotomayor-Rios**. *Dept. of Crop Prot., Univ. of P.R., Mayaguez and **M.I.T.A., USDA, Mayaguez 00708.

Fungi from 23 genera were isolated from seeds of 30 grain sorghum lines growing in humid environments in Puerto Rico. The most common in order of decreasing incidence were *Curvularia*, *Fusarium*, *Phoma*, *Colletotrichum*, and *Nigrospora*. Genera with 2 or more species seedborne were *Curvularia* (*C. lunata* and *C. brachyspora*), *Fusarium* (*F. moniliforme*, *F. semitectum*, and *F. acuminatum*), and *Colletotrichum* (*C. graminicola* and *C. gloeosporioides*). High incidence of *Curvularia* spp. and *Fusarium* spp. were associated with decreased seed appearance, weight and viability. Resistance to seed deterioration varied among cultivars. Two lines showed above 90% germination and 1 showed 30% germination at physiological maturity; the other lines varied within these extremes. After 1, 2, and 3 weeks delayed harvest, numbers of seed with fungal signs increased and germination decreased.

SEROLOGICAL AND HOST DIFFERENCES AMONG PERUVIAN, ECUADORIAN, AND NORTH AMERICAN POTATO VIRUS Y ISOLATES. E.N. Fernandez-Northcote, Universidad Nacional Agraria La Molina — Centro Internacional de la Papa, Apartado 5969, LIMA—PERU.

Potato virus Y (PVY) isolates of the Y^N and Y^O group of strains collected in Peru and Ecuador, respectively, gave a reaction of partial identity with a Peruvian isolate of the Y^O group and its homologous antiserum in sodium dodecyl sulfate (SDS)-agar double diffusion. Peruvian and North American (USA) Y^O group isolates gave a reaction of identity with this antiserum. Peru tomato virus (PTV) a related potyvirus did not react. Peruvian PVY^O and PVY^N and USA PVY^O isolates gave a reaction of partial identity, Ecuadorian PVY^O isolates did not in reciprocal tests with the M4 type isolate of PTV and its antiserum. This reaction was different in position and intensity than the one observed among PVY strains. Differences among strains in SDS-agar double diffusion tests have been reported previously only for turnip mosaic virus. Peruvian isolates of the PVY^O group that do not produce necrotic local lesions on detached leaves of potato clone A6 were detected. Isolates from Ecuador induced very mild symptoms in Nicotiana tabacum 'White Burley'. Peruvian and Ecuadorian isolates did not infect Capsicum annuum 'Agronomico', 'Avelar' and 'Ruby King', in contrast, USA PVY^O isolates infected only Ruby King.

CYTOPLASMIC CYLINDRICAL INCLUSIONS INDUCED BY PERU TOMATO VIRUS (PTV). E.N.Fernández-Northcote, and R.W.Fulton. Universidad Nacional Agraria La Molina, Aptdo. 456, Lima-Perú, and Dept. of Plant Pathology, University of Wisconsin, Madison, Wisconsin 53706, U.S.A.; respectively.

Two strains of Peru tomato virus (PTV-N and PTV-M) and a common strain of potato virus Y (PVY), induced the same type of cytoplasmic cylindrical inclusions. In cross sections pinwheels, and in longitudinal sections abundant fibrous bundles, were observed. There were few scrolls and very few typical laminated aggregates. These results are consistent with the grouping of PTV as a potyvirus.

PREVALENCE OF POTATO VIRUS Y RELATIVE TO OTHER POTATO VIRUSES IN ECUADOR AND CHILE. E.N.Fernández-Northcote, J.G.Vega, and G. Apablaza. Universidad Nacional Agraria La Molina-International Potato Center Aptdo.5969, Lima-Perú; INIAP, Aptdo.340, Quito, Ecuador; and Universidad Católica, Casilla 144-D, Santiago-Chile; respectively.

In each country 40% of the samples were analyzed by the latex serological test for potato virus Y(PVY), potato virus X(PVX), potato virus S(PVS), Andean potato latent virus and Andean potato mottle virus. The other 60% were used for detection of PVY by the microprecipitation drop test. In Ecuador 94 potato fields visited, were at altitudes ranging from 2,300 to 3,550 m.a.s.l. Most of the fields were severely affected by mosaics, and to a lesser extent by yellow vein disease. Symptoms of potato leafroll were absent. In 400 samples PVS was the most prevalent followed by PVY and PVX. In Chile 54 potato fields visited were at 50-100 m.a.s.l. Mosaics were most important, followed by potato leafroll virus. In the south, cultivars introduced more than 10 years ago still presented a very low incidence of mosaics. From 200 samples PVS was the most prevalent followed by PVX and PVY. In the south of Ecuador and central part of Chile, incidence of PVY was higher than in other regions. Andean potato latent virus was present in Chile and this is the first report of its incidence.

EVALUACION DE LOS DAÑOS OCASIONADOS POR DRECHSLERA ORYZAE Y TRICHOCONIS PADWICKII EN SEMILLAS DE ARROZ. Alejandro Ferrer Z. M. Garuz y O. Pacheco. Instituto de Investigación Agropecuaria de Panamá. Apdo. 6-4931, Estafeta El Dorado. Panamá 6, Panamá.

Utilizando la prueba del papel secante, se detectaron semillas de arroz afectadas por hongos patógenos. Semillas afectadas por Drechslera oryzae y Trichoconis padwickii, fueron divididas en categorías I y II de acuerdo al crecimiento del hongo.y sembradas en bandejas con suelo no-estéril y observadas por 21 dias. El porcentaje de mortalidad de las semillas afectadas por D. oryzae fue de 60% y 94% para las categorías I y II respectivamente. En semillas afectadas por T. padwickii, la mortalidad fue de 71% para ambas categorías. La diferencia entre la germinación de semillas altamente afectadas por hongos patógenos y semillas relativamente sanas, solo pudo observarse en bandejas con suelo no-estéril. Las pruebas realizadas en germinadores eléctricos no mostraron diferencias entre ambos grupos de semillas.

SOURCE OF INOCULUM AND DEVELOPMENT OF WEB-BLIGHT OF BEANS IN COSTA RICA. J.J. Galindo, G.S. Abawi, H.D. Thurston, and G.E. Gálvez, Dept. of Plant Pathology, Cornell Univ., Ithaca, N.Y. 14853 and CIAT, Coronado, Costa Rica.

Web-blight (WB) of beans incited by *Thanatephorus cucumeris* was studied in a field with a history of severe WB incidence located near Esparza (ca. 200 m altitude, 2300 mm rainfall, and 26 C). Porrillo 70 (WB-tolerant) and Mexico 27 (WB-susceptible) were planted in replicated plots on May 20, 1980. Primary leaves of both cvs became 100% infected at 21 days after planting. Sclerotia and infected organic debris in soil that was splashed onto plant parts by rain was the primary inoculum source. The perfect state of the fungus developed on 1% of the plants at 28 days; however, no basidiospore infections occurred. The latter occurred during extended rainy periods in 1979 as small, circular lesions. Trifoliate leaves became infected by splashed inoculum but more often by advancing hyphae from infected tissues. Severely infected plants of both cvs became defoliated at 35 days and produced no seeds. Mulching with rice-husks gave good control of WB by reducing splashed inoculum.

VIRUSES AND APHIDS ASSOCIATED WITH COMMELINA MOSAIC IN PUERTO RICO. O. González, Margarita Licha and J. Bird, Dept. of Crop Protection, University of Puerto Rico, Río Piedras, Puerto Rico 00928.

In Puerto Rico *A. gossypii* occurs on *Commelina diffusa* but its incidence is usually very low and not commensurate with the abundance of cucumber mosaic. Thus, the relatively high incidence of cucumber mosaic on *C. diffusa* in Puerto Rico could not be attributed solely to the intervention of *A. gossypii*. *Amphorophora commelinensis* was suspected to be the main vector of cucumber mosaic from *Commelina* to *Commelina* as well from *Commelina* to plantains and bananas in Puerto Rico. Transmission tests and surveys on incidence and distribution confirmed our suspicions. Besides being a widely distributed form and an efficient vector, *A. commelinensis* is capable of breeding on plantains and bananas. Two different viral particles (isometric and filamentous) were detected in dips prepared from mosaic-affected *Commelina* leaves in Puerto Rico.

A COMPARISON OF THE BIOLOGICAL ACTIVITY OF TWO FORMULATIONS OF FENTIN-HIDROXIDE. John M.Hammond,Griffin Corporation, P.O.Box 1847 Valdosta, GA. USA 31601.

It has been documented that formulation affects the biological activity of the active ingredient of pesticides. Field tests were conduced in the southern U.S. to test the activities of two formulations of the fungicide fentin-hydroxide (FTH). Comparisons were made between a wettable powder (WP) formulation and a flowable formulation for control of several pathogens in soybeans and ground-nuts. The primary pathogens which a affected soybeans were Colletotrichum dematium var.truncata, Diaporthe phaseolarum var. sojae, and Septoria glycines, and for groundnuts Cercospora arachidicola and Cercosporidium personatum. Data developed in multi-state university tests indicate that the flowable formulation gave equivalent disease control when it was used at doses 25% less than the WP dose. Comparisons between the two formulations including particle size, particle configuration, particle size distribution and surface area as they relate to the observed improvement in disease control of the flowable will be discussed.

PARTIAL CONTROL OF *FUSARIUM MONILIFORME* SEED INFECTIONS IN SORGHUM WITH APPLICATION OF METHIOCARB INSECTICIDE. P. R. Hepperly*, C. Feliciano*, and A. Sotomayor-Rios**, *Dept. of Crop Prot., Univ. of P.R., Mayaguez and **M.I.T.A., USDA, Mayaguez 00708.

Studies were conducted to determine why plants sprayed with methiocarb, a broadspectrum insecticide produced seed of increased germination compared to nonsprayed plants. Sorghum head molds are usual causes of germination losses. However, methiocarb showed no fungicidal activity in vitro. Field plants sprayed weekly with methiocarb (1 kg/ha) produced seed with 46% fewer *Fusarium moniliforme* infections and 30% greater germination than controls. Plants sprayed weekly with benomyl-captan (0.5 + 0.5 kg/ha) or the same plus methiocarb completely controlled *F. moniliforme* and produced seed with 25% greater germination compared to methiocarb alone. Partial control of *F. moniliforme* and increased seed quality with methiocarb was associated with control of sorghum web worm and other insects Insect activity may increase *F. moniliforme* dispersal and development in sorghum.

RHIZOCTONIA WEB BLIGHT ON SOYBEANS IN PUERTO RICO. P. R. Hepperly, J. S. Mignucci, R. S. Smith, Dept. of Crop Protection, Univ. of P.R., Mayaguez, Puerto Rico 00708.

A natural web blight epidemic was followed in two 'Davis' soybean fields, one sprayed weeekly with benomyl and another nonsprayed. Symptoms appeared during pod fill and at full green pod stages for nonsprayed and sprayed fields, respectively. Disease foci number and size increased with bean maturity particularly after yellow pod stage. At harvest 53 and 18 disease foci were found in nonsprayed and sprayed fields, respectively. The maximum focus area was 12.1 and 2.3 M^2 for the two respective fields. *R. solani* infected 5% of seed from web blighted plants but not seed from plants without web blight. In the nonsprayed field, web blighted plants had lower incidence of fungal seed infection and higher germination than nonblighted plants. Recovieres of seedborne *Phomopsis* sp., *Colletotrichum dematium*, *Botryodiploidia theobromae* and *Curvularia lunata* were significantly lower in web blighted plants than nonblighted plants.

PINE HOSTS OF THE PITCH CANKER FUNGUS (FUSARIUM MONILIFORME VAR. SUBGLUTINANS) IN ALABAMA SEED ORCHARDS. W. D. Kelley, Dept. Botany, Plant Pathology, and Microbiology, Auburn University, AL 36849, U.S.A.

Pitch canker, caused by Fusarium moniliforme Sheld. var. subglutinans Wollenw. and Reink., is causing severe damage in loblolly (Pinus taeda L.), shortleaf (P. echinata Mill.), and Virginia (P. virginiana Mill.) pine seed orchards in Alabama; slash (P. elliottii Engelm.) and longleaf (P. palustris Mill.) pine seed orchards have not been surveyed. The most severe damage was observed on shortleaf pine where in one orchard over 50% of the trees had been killed and removed from the orchard. Pitch cankers on Virginia pine were most often found on large lateral limbs and the main stems. Copious resin flow was evident emanating from infection sites, but no mortality was observed. On loblolly pine, pitch canker caused a shoot dieback of the first flush of spring growth. Although resin-soaked xylem tissues subtended symptomatic shoots, no copious resin flow was visible externally. No fungicidal control is known.

RESISTANCE IN SACCHARUM SPONTANEUM AND SACCHARUM-RELATED GENERA TO SUGARCANE MOSAIC AND RATOON STUNTING DISEASES. H. Koike, U.S. Sugarcane Field Laboratory, AR, SEA, USDA, Houma, Louisiana.70361

Varieties of Saccharum spontaneum and species of Saccharum-related genera totaling 45 clones were inoculated with a mixture of sugarcane mosaic virus strains H and I (the predominant strains in Louisiana). Another 44 clones were inoculated with sugarcane stalk juice containing the infectious agent of ratoon stunting disease (RSD). Most clones were tested for both diseases. Twenty-nine clones were found resistant to mosaic, lacking mosaic symptoms both in the inoculated host and in Rio sweet sorghum assay plant. These clones may be useful in breeding for mosaic resistance. All 44 tested clones appeared to be susceptible to RSD infection as judget by the presence of the RSD-associated bacterium. The bacterium occurred in the xylem fluid of all tested clones, whether or not they exhibited nodal discoloration typical of RSD-infected sugarcane.

EFFECT OF TEMPERATURE AND PH ON LINEAR GROWTH OF *ASCOCHYTA PHASEOLORUM* SACC. Ligia Lebrón, Pedro L. Meléndez and Rocio del Pilar Rodríguez, Dept. of Crop Protection, Univ. of P.R., Mayaguez, Puerto Rico 00708.

The effect of temperature and pH on linear growth of *Ascochyta phaseolorum* Sacc. was studied using isolates from *Phaseolus vulgaris*, *P. coccineus*, *Vigna unguiculata*, *Canavalia maritima*,

Citrus aurantium, and *Solannum melongena*. The isolates were grown on potato dextrose agar adjusted to pH values of 4.0, 7.0 and 9.0. Cultures were incubated at 24, 28, 32, and 36°C. With few exceptions response to pH and temperature was similar for all isolates. Optimum growth occurred at 24°C and pH 9.0, and minimum at 32°C and pH 4.0. No growth was evident at 36°C. A statistically significant interaction was found between temperature and pH for growth of these isolates of *A. phaseolorum*. Supported in part by USAID/UPR Contract AID/ta-c-1296.

EFFECT OF VARIOUS MEDIA ON CALLUS FORMATION, PROLIFERATION AND PLANTLET DEVELOPMENT IN TANIER (*XANTHOSOMA* SPP.). Margarita Licha, Delia Baella, R. Trifiro and L. J. Liu. Agr. Expt. Sta. Univ. of P.R., Mayaguez Campus, Río Piedras, Puerto Rico 00928.

Meristem tips of tanier (*Xanthosoma* spp.) were cultured in Murashige & Skoog (MS) AZ, RT (Revised Tobacco) and Gamborg's B5 media. Excellent callus formation was obtained with Gamborg's B5 medium. A modified MS medium, containing 2.0 mg/l glycine, 5.0 mg/l IAA and 2.0 mg/l kinetin, enhanced sprouting, proliferation, rooting and also callus formation. More than 5,000 tanier plantlets were produced through the use of this medium. It is estimated that more than 150,000 presumably virus-free plantlets can be produced in a 2-year period. Supported in part by USDA, Cooperative Agreement No. 58-7B30-9-115 (TAD Research Grant).

VARIATION IN UREDIOSPORE AND TELIOSPORE MORPHOLOGY OF *PUCCINIA MELANOCEPHALA* ON SUGARCANE. L. J. Liu, Dept. of Crop Protection, Agr. Exp. Sta., Univ. of P.R., Mayaguez Campus, Río Piedras, Puerto Rico 00928.

Morphological studies of *Puccinia melanochephala* urediospores and teliospores from the Dominican Republic, Puerto Rico, Jamaica, Belize, Venezuela, Colombia and Taiwan revealed that, except for specimens from Taiwan, the largest urediospores and teliospores were those from Jamaica (35.32-37.33 X 24.78-28.89 u for urediospores and from 47.55-49.73 X 20.67-23.10 u for teliospores). The smallest spores were those from Colombia (33.37-36.42 X 21.84-25.01 u for urediospores, and from 41.16-50.41 X 20.77-21.75 u for teliospores). Differences in sizes within urediospores and teliospores were significant, but both types of spores generally fell within the confines accepted for *Puccinia melanocephala*. The specimens from Taiwan were identified as *P. kiehnii*. The urediospores had thickened apical walls, and were larger than those of *P. melanocephala*. No teliospores were found.

RESPONSE OF RICE TO MERTECT 340-F FUNGICIDE

M. G. McDaniel
P. O. Box 391
Little Rock, AR 72203

Dr. Fleet N. Lee
P. O. Box 351
Stuttgart, AR 72160

Losses from rice diseases in Arkansas annually exceed 10 percent and are increasing because of more intensive cultural practices that favor diseases such as Sheath Blight (*Rhizoctonia solani*), Blast (*Pyricularia oryzae*), and Stem Rot (*Sclerotium* spp.). Over 45 percent yield loss has been observed in specific situations. Disease losses can be effectively reduced by employing certain preventive measures. Work with fungicides, in general, has not resulted in highly significant yield increases but generally has given profitable returns. Small plot and field use of fungicides needs further evaluation and refinement to fully determine their potential.

FACTORS INFLUENCING FIELD DEVELOPMENT OF SOYBEAN ANTHRACNOSE IN PUERTO RICO. J. B. Mendoza, J. S. Mignucci, P. R. Hepperly, and G. Riveros. Dept. of Crop Prot., Univ. of P.R., Mayaguez 00708.

During the 1980 rainy season *Collectotrichum dematium* on soybean pods increased from 14 to 42% incidence under natural infection and from 16 to 75% incidence after artificial inoculation. Weeded and nonweeded plots did not differ significantly in pod infection. One, 2, 4 and 6 benomyl sprays reduced pod infection by 12, 15, 19, and 48%, respectively. Recovery of *C. dematium* from seeds on PDA was significantly greater in nonweeded (27.4%) compared to weeded plots (14.8%). Seed germination was significantly higher in seeds from weeded compared to unweeded plots. Pod infection in weeded and nonweeded plots appeared to increase in proportion to the rainfall in the week previous to rating.

THE PREVALENCE AND SEVERITY OF COFFEE DISEASES IN PUERTO RICO. J. S. Mignucci and P. R. Hepperly. Dept. of Crop Prot., Univ. of Puerto Rico, Mayaguez 00708.

Seeds, seedlings and mature plants of coffee were surveyed in 20 farms at 5 municipalities in October 1979. Anthracnose was the most common and severe field disease. In one farm, 30% of 8-year old trees had 40 to 70% branch and twig die back and 40% of the harvested berries were mummified and floated during washing. *Colletotrichum gloeosporioides* (*Glomerella cingulata*) and *Phomopsis* sp. were consistently isolated from branches with anthracnose symptoms. Thread blight (*Pellicularia koleroga*) and wilt (*Fusarium oxysporum*) were found on 10% of the farms with incidence of 20 and 2%, respectively. Forty to 60% of seedbed seedlings were lost to pre-or post-damping-off by *F. oxysporum*. On seedlings in polyethelene bags, brown spot (*Cercospora coffeicola*) had high incidence but low severity. Seeds selected for planting had 82% germination and 5% *F. solani*. Tap root necrosis associated with *F. oxysporum* and *F. equiseti* developed in 59% of these seedlings.

LETHAL ROOT ROT OF COFFEE IN PUERTO RICO. J. S. Mignucci and P. R. Hepperly, Dept. of Crop Protection, University of Puerto Rico, Mayaguez, Puerto Rico 00708.

Coffee lethal root rot, a new disease in Puerto Rico, was identified on 6-year-old coffee trees in Jayuya. Infected trees showed yellowing and wilting and a decline of vigor and yield. Roots were covered by a white fungal mantle forming a spongy mass several diameters larger than non-infected roots. Fleshy basidiocarps developed at the base of infected trees which were first white (25-35 mm dia.) and later rusty brown (110-160 mm dia.). The fungus produced spiny basidiospores with two distinct walls characteristic of *Ganoderma* species. Measurements and characteristics of basidiospores, basidiocarps, and root mantle fit the description of *Ganoderma phillipii*. A pure culture of the fungus caused root rot of 3-month-old coffee seedlings 10 days after inoculation. Twelve and 26 of 40 trees showed lethal root rot in fall 1979 and in spring 1980, respectively. Removal and burning of infected trees and replanting with bananas have been recommended for control of this disease.

AN IMPROVED MEDIUM FOR TISSUE CULTURE OF YAM (*DIOSCOREA* SPP.) IN PUERTO RICO. Amelia Cortés Monllor, L. J. Liu, and Eva Arroyo, Dept. of Crop Protection, Agr. Exp. Sta. Univ. of P.R., Mayaguez Campus, Río Piedras, Puerto Rico 00928.

Meristem tips and nodal segments of commercial yams (*Dioscorea rotundata*, cv. Habanero; and *D. alata*, cvs. Florido, Smooth Statia, Leon Globe and Gunung) were cultured in AZ, White, RT (Revised Tobacco) and Murashige and Skoog media. The latter medium, modified by increasing sucrose (30 g/l) and by adding kinetin (2 mg/l), IAA (2 mg/l) and NAA (1 mg/l) enhanced proliferation and root development of the plantlets. Plantlets were rapidly multiplied by subdividing regenerated plants every 3 months. With this proliferation cycle, more than 400 plantlets were obtained in 3 months from nodal segments of cv. Habanero (*D. rotundata*). It is estimated that this technique will facilitate the production of approximately 109,000 presumably virus-free plantlets in a 2-year period. Supported in part by USDA, Cooperate Agreement No. 58-7B30-9-115 (TAD Research Grant).

BUBA OF MANGO (*Mangifera indica* L.)IN THE STATE OF SINALOA, MEXICO. Sóstenes Montoya Angulo and José Ramírez Villapudua. Esc. Sup. de Agric., Apdo. Post. 726, Cualican, Sin. Méx.

In native mango orchards, a disease commonly known as "nanahuate" "bolas" or "buba of mango", has been present for more than 20 years. Symptoms are galls or balls on branches and stems and are formed by a large number of tight gems that have numerous scales instead of leaflets, giving a cawliflower like aspect. They measure from 5 to 10 cm in diameter and for some months they are light green, but finally after death, they turn dark brown and remain attached to the tree for many years. The branches of several affected trees dry up. From the fungi isolated from afected parts, only *Fusarium rigidiusculum* reproduced the symptoms. The symptoms and causal agent are similar to those of buba of green tips in *Theobroma cacao* L.

EVALUACION DE 32 VARIEDADES DE FRIJOL COMUN (*Phaseolus vulgaris*) AL ATAQUE DE LA MAYA BLANCA CAUSADA POR *Sclerotium rolfsii*(sacc). B. Mora, A. Morales y G. Gálvez, Programa Na-

cional de Leguminosas de Grano, MAG-UCR y CIAT, Apdo. 55 Coronado, San José, Costa Rica.

En la zona de Upala-Costa Rica, se evaluaron 32 líneas de fríjol. Estas fueron infectadas severamente por la "maya blanca". Se observó que existe tolerancia genética en algunas líneas al hongo. Se evaluó el daño en base a número de plantas muertas, número de plantas con vaina y rendimiento. Hubo una correlación positiva entre las variables estudiadas y el rendimiento. Las siguientes líneas mostraron buena tolerancia : G2618 (1454 kg/ha), BAT 338 (1342 kg/ha), BAT 317 (1300 kg/ha), BAT 202 (1231 kg/ha) y BAT 482 (1225 kg/ha). El testigo local produjo 537 kg/ha, mientras que las líneas 23, 24 y Empoasca 28 fueron altamente susceptibles con rendimientos inferiores a los 450 kg/ha.

INTERACTION BETWEEN *MELOIDOGYNE* AND *FUSARIUM OXYSPORUM* F. SP. *COFFEAE* ON COFFEE. J. Negrón, Nelia Acosta and Julia Mignucci, Dept. of Crop Protection, Univ. of P.R., Mayaguez, Puerto Rico 00708.

To determine the possible interaction of *Meloidogyne incognita* and *Fusarium oxysporum* f. sp. *coffeae*, coffee (*Coffea arabica*) seedlings were subjected to inoculation with the fungus alone; inoculation with the nematode alone; inoculation with the fungus and the nematode simultaneously; inoculation with the nematode and two weeks later with the fungus; inoculation with the nematode and four weeks later with the fungus; and check. Chlorosis, root necrosis, wilting and dwarfing were significantly greater in plants inoculated with the fungus four weeks after inoculation with the nematode than in plants inoculated at two weeks later or with either pathogen alone. No significant differences between treatments were found for plant and root growth. Infected roots revealed development of giant cells and colonization by the fungus of these cells, the xylem vessels, and the female nematode itself.

EFFECT OF CULTURE FILTRATES FROM SEVERAL MICROORGANISMS ON IN VITRO GROWTH OF SOME FUNGAL PATHOGENS OF BEANS (*PHASEOLUS VULGARIS* L.). Olga Odiott, P. L. Meléndez, and Rocío del Pilar Rodríguez, Dept. of Crop Protection, Univ. of P.R., Mayaguez, Puerto Rico 00708.

Fresh potato dextrose agar was admended with culture filtrates from *Trichoderma harzianum*, *Penicillium* sp., and 3 bacterial isolates grown in potato dextrose broth. Nine-cm culture plates were inoculated with 2-mm discs of *Ascochyta phaseolorum Sclerotium rolfsii*, *Macrophomina phaseolina*, *Rhizoctonia macrosclerotia*, and *Thanathephorus cucumeris* and incubated at 28°C. Fungal growth was measured at 24, 48, and 72 hrs. of incubation. The filtrate of *T. harzianum* reduced growth of *M. phaseolina*, *S. rolfsii*, and *T. cucumeris*. The *Penicillum* sp. filtrate inhibited growth of *M. phaseolina* only. Filtrates from the bacterial isolates were inhibotory to *R. macrosclerotia*, *S. rolfsii*, and *M. phaseolina*. Supported in part by USAID/UPR Contract AID/ta-c-1296.

RELATION OF PLANTING TIME AND EXTERNAL APPEARANCE OF SEED FROM TWO BEAN (*PHASEOLUS VULGARIS*) CULTIVARS TO GERMINATION AND INCIDENCE OF INTERNALLY BORNE FUNGI. Mirta Rivera de Christian, P. L. Meléndez and J. H. López-Rosa, Dept. of Crop Protection, Univ. of P.R., Mayaguez, Puerto Rico 00708.

The dry bean (*Phaseolus vulgaris*) (cvs. Bonita and Naranjito) were grown during the rainy and dry seasons, in Lajas, Puerto Rico and assayed for apparent disease (AD), germination, and seed-borne fungi. Differences in AD were evident between both cultivars in the rainy, but not in the dry season. Per cent of seed with AD was higher and germination was lower in the rainy than in dry season. Germination of seed from both cultivars at both harvests was negatively correlated with total number of seedborne fungi. *Fusarium* sp. and *Rhizoctonia solani* were most frequently isolated during the rainy and dry seasons, respectively. Bonita generally germinated better and was apparently less disease affected than Naranjito seed. Per cent seed-borne fungi was greater and germination was lower from seed which appeared to be diseased than from apparently healthy seed.

VIRUS-LIKE PARTICLES ASSOCIATED WITH RHYNCHOSIA MOSAIC. Rita L. Rodríguez, Dept. of Crop Protection, Agr. Exp. Sta., Río Piedras, Puerto Rico 00928.

The whitefly-borne mosaic of *Rhynchosia minima* was readily transmitted from bean to bean using phosphate buffer and Na DIECA. Infection rates of up to 80% were achieved employing the stated adjuvants. Geminate virus-like particles resemblin those already associated with other viruses transmitted by the Whitefly *Bemisia tabaci* were observed in dips prepared from infected plants.

CHEMICAL CONTROL OF RICE BLAST IN PUERTO RICO. A. Rodríguez Marcano, J. Lozano, and L. J. Liu, Dept. of Crop Protection and SEA-AR/USDA Cooperative Project, respectively, Agr. Exp. Sta., Univ. of P.R., Mayaguez Campus, Río Piedras, Puerto Rico 00928

Benomyl, chlorothalonil and thiabendazole were applied, at various rates, at the booting and heading stages to control natural blast (*Pyricularia oryzae*) infection on rice (*Oryza sativa*) in Gurabo, Puerto Rico. Benomyl (0.57, 1.12 and 1.71 kg/ha), chlorothalonil (0.60 and 0.90 1/ha) and thiabendazole (0.48 and 0.90/ha) improved panicle appearance as compared to the check. In a second trial, only thiabendazole at the highest rate (0.90 1/ha) and chlorothalonil at the lowest rate (0.48 1/ha) improved appearance. Treatment with benomyl delayed maturity and increased per cent of green seed at harvest. Less green seed was detected in thiabendazole and chlorothalonil sprayed plots. Although fungicide applications appeared to reduce panicle blast, yield did not increase significantly except for plants treated with thiabendazole (0.48 1/ha), that promoted a 35% increase.

INCIDENCE OF FUNGI ON RICE SEED FROM FUNGICIDE TREATED PLANTS. A. Rodríguez Marcano, Amelia Cortés Monllor, and L. J. Liu, Dept. of Crop Protection, Agr. Exp. Sta., Univ. of P.R.-Mayaguez Campus, Río Piedras, Puerto Rico 00928.

One hundred rice (*Oryza sativa*) seeds from plots treated with thiabendazole and chlorothalonil at 0.48, 0.60 and 0.90 1/ha and benomyl at 0.57, 1.12 and 1.71 kg/ha were disinfected in a 0.5% sodium hypochlorite solution for 3 min., rinsed twice in sterile distilled water and planted in potato dextrose agar. *Curvularia* sp., *Helminthosporium oryzae*, *Fusarium* sp. and *Piricularia oryzae* were isolated from all samples. Seeds from thiabendazole and chlorothalonil treated plots had a lower percentage of *P. oryzae* than seeds from benomyl-treated (1.12 and 1.71 kg/ha) and check plants. High incidence of *Curvularia* sp. was detected on seeds from all benomyl treated plots. Recovery of *H. oryzae* from chlorothalonil treated plots was lower than from thiabendazole and benomyl-treated plots. Per cent isolation of *Fusarium* sp. was low, but still higher than *H. oryzae* in all treatments.

ROOT ROT OF TANIER (*XANTHOSOMA* SPP.) IN PUERTO RICO. A. Rodríguez-Marcano and J. López Rosa, Dept. of Crop Protection, Agr. Exp. Station, Univ. of Puerto Rico, Mayaguez Campus, Río Piedras, Puerto Rico 00928.

A disease of tanier (*Xanthosoma* spp.), characterized by root deterioration, stunting of the plant, yellowing of oldest leaves and very poor yield has become serious in Puerto Rico. Disease symptoms usually appear two-three months after plant emergence. The malady has been associated with high soil moisture and poor drainage. *Rhizoctonia solani* was isolated from cankered roots, cormels and corms (45.2, 51.2, and 13%, respectively). *Fusarium* sp. was isolated from 34.6, 20.0, and 22% of the affected roots, corms and cormels, respectively. A phycomycete was isolated from 48.0% of the corms, 17.3% of the roots and 8% of the cormels. *Rhizoctonia* hyphae were observed in diseased tissue. The high incidence of *Rhizoctonia* and *Fusarium* in roots suggests that these organisms may play a major role in the tanier root rot complex or "mal seco".

EVALUATION OF SELECTED SOYBEAN CULTIVARS IN A FIELD INFESTED WITH MELOIDOGYNE ARENARIA AND HETERODERA GLYCINES. R. Rodriguez-Kabana and D. L. Thurlow. Departments of Botany, Plant Pathology, and Microbiology; and Agronomy and Soils, respectively, Auburn University, AL 36849, U.S.A.

Soybean cultivars were studied for 2 years in a field in South Alabama, U.S.A., infested with a mixed population of the root-knot nematode Meloidogyne arenaria and race 3 of the cyst nematode Heterodera glycines. Cultivars in the study, selected for their relative tolerance to either parasite, were: Bedford, Braxton, Bragg, Centennial, Cobb, Davis, Dowling, Forrest, Govan, Hutton, Ransom, and F-70-2060. Each cultivar was planted in untreated plots and in plots fumigated with EDB (Soilbrom(R) 90 EC). A significant negative correlation was detected between larval populations of H. glycines and M. arenaria indicating

that resistance to H. glycines in a given cultivar resulted in increased larval populations of M. arenaria. Fumigation was more efficacious against M. arenaria than against H. glycines. The best nematode control and yield responses were obtained when cyst resistant cultivars, Bedford, Forrest, and Centennial were planted in fumigated soil.

EFFECT OF HOPLOLAIMUS GALEATUS AND OTHER NEMATODES ON YIELD OF SELECTED SOYBEAN CULTIVARS. R. Rodriguez-Kabana and D. L. Thurlow, Departments of Botany, Plant Pathology, and Microbiology and Agronomy and Soils, respectively, Auburn University, AL 36849, U.S.A.

Field experiments were conducted in 1975, 1977, 1978 and 1979 at Tallassee, Alabama to determine the degree of damage caused by Hoplolaimus galeatus alone and in combination with Meloidogyne incognita, Paratrichodorus christiei, Pratylenchus brachyurus, and Tylenchorhynchus claytoni on selected soybean cultivars. Control of H. galeatus with planting time applications of DBCP (14 L/ha) resulted in significant increments in yield of most soybean cultivars in an experiment where the nematode was the only parasite. In another experiment, the combination of H. galeatus with Meloidogyne incognita resulted in the greatest yield loss recorded for all experiments as measured by response to DBCP treatment. Control of P. brachyurus and P. christiei in combination with low numbers of H. galeatus also resulted in significant yield responses. Results suggested that losses from T. claytoni were not important at the levels of infestation tested.

PHYSIOLOGICAL RACES OF UROMYCES RUST OF BEANS IN PUERTO RICO. Hernán Ruiz, Pedro L. Meléndez and Rocío del Pilar Rodríguez, Dept. of Crop Protection, Univ. of Puerto Rico, Mayaguez, Puerto Rico, Mayaguez, Puerto Rico 00708.

Thirty-five isolates of bean rust (*Uromyces appendiculatus* (Pers.) Unger) were collected from 9 municipalities in Puerto Rico in 1976. Eighteen races were identified from these collections, six of which were new. The 18 races were tested on twenty-three bean (*Phaseolus vulgaris* L.) cultivars in the greenhouse. Cultivars PI 199043-A, PR-S-15R35 BK, Ecuador 299, Mexico 309, Galana, PR-S-70-15R42 1 BK, and La Vega were highly resistant or inmune to all 18 races. Naranjito, PI 499049, R17ABKA, Diablo, Pomadur and Borinquen were resistant to the majority of the races, while all other cultivars were susceptible to all races. The resistance reactions evident in the greenhouse should be confirmed in the field. Supported in part by USAID/UPR Contract AID/ta-c-1296.

EFFECT OF VARIOUS MEDIA ON MERISTEM CULTURE FOR THE PRODUCTION OF RUST RESISTANT SUGARCANE. G. Trifiro and L. J. Liu, Dept. of Crop Protection, Agr. Exp. Sta., Univ. of P.R., Mayaguez Campus, Río Piedras, Puerto Rico 00928.

Meristem tips of sugarcane varieties B4362, Q90, Co 798, PR 67-3129, and PR 64-2705 were cultured in Murashige and Skoog medium (MS), Revised Tobacco medium (RT) and MS supplemented with peptone (MS + P). Callus formation was best in MS for varieties CP 57-603, PR 67-3129, Co 798, Q90, and PR 64-2705. B 4362 performed fairly well in MS and RT. In MS, a wide range of responses as to quality of callus growth rate and oxidation was observed in the studied varieties. Differentiation, was better in MS for all varieties. Leaf differentiation occurred first in the control CP 57-603 and the two PR varieties (67-3129 and 64-2705), and B 4362 (MS only). Root differentiation occurred first on B 4362 on RT medium. The plantlets will be inoculated with the sugarcane rust fungus, *Puccinia melanocephala*.

Disease resistance in Phaseolus species--A summary of the Central American Expedition. Nader G. Vakili, 421 Bessey Hall, Iowa State University, Ames, Iowa 50011

Wild Phaseolus vulgaris accessions collected by H. S. Gentry in Central Mexico (1966-67) were susceptible to CBMV, CPMV, Xanthomonas phaseoli, Isariopsis griseola, Colletotrichum lindemuthianum, and Uromyces appendiculatus. P. coccineus accessions were resistant to the same pathogens. Tropical P. vulgaris cultivars resemble the wild P. vulgaris both in morphology and breeding habit, but have the resistance of P. coccineus. An expedition to the humid tropics of southern Mexico and Guatemala was conducted in which relationship between wild Phaseolus populations and disease were surveyed. Species similar to P. vulgaris were found in the highly humid but cool climate growing in dense vegetation. In all but one location, the P. vulgaris types were either solitary or a few scattered vines. P. coccineus often covered large patches of forests and mountain sides. The extensive growth of the wild P. coccineus suggests its ability to survive and resist stress.

YIELD LOSS FACTOR, A CRITERION FOR TOLERANCE AND RESISTANCE TO BEAN RUST. Nader G. Vakili, 421 Bessey Hall, Iowa State Univ., Ames, Iowa 50011.

A method of measuring standard values for the relationship between yield loss (YL) in *Phaseolus vulgaris* and *Uromyces appendiculatus* is proposed. Maximum YL is the difference between the yield ratio of the standard susceptible (S) from that of the standard immune (I). The YL factor (a) is derived by dividing the YL of a test cultivar by that of the standard S cultivar. An arbitrary, but useful disease scale is: a = 0.00 immune; a = 0.25, threshold between high and moderate resistance; a = 0.50, demarcation between moderate resistance and susceptibility; and a = 1.00, the highest yield loss factor for a susceptible response. Cultivar La Vega (a = 0.45), which has the response of the standard S, but the yield of a resistant cultivar, is a true tolerant. Supported in part by USAID/UPR Contract AID/ta-c-1296.

BIOLOGY OF SOYBEAN RUST IN PUERTO RICO. Nader G. Vakili, 421 Bessey Hall, Iowa State University, Ames, Iowa 50011.

Phakopsora pachyrhizi is endemic in Puerto Rico and infects various legumes on the Island. This pathogen is prevalent at 450 to 750 m elevation, average annual range of 23 to 17°C, and precipitation of 150 to 260 cm. The fungus overseasons in the perennial *L. purpureus* during the dry season and increases in the other species during the wet season. Inoculation of five legume species in controlled environment chambers resulted in infection intensity, lesion size, and sporulation rates that were moderately suppressed at 15.5 C, greatest at 20.5 C, and lowest at 27 C. Inheritance of resistance in *P. coccineus* to *P. pachyrhizi* seemed to be governed by either additive factors, plasmogenes or a combination of both. Supported in part by USAID/UPR Contract AID/ta-c-1296.

CERCOSPORA SOJINA: ITS RELATION TO DEFOLIATION, REDUCED SEED WEIGHT, SEED INFECTION AND WITH OTHER SEEDBORNE PATHOGENS OF SOYBEAN. J. T. Yorinori and J. B. Sinclair. Dept. of Plant Pathology, University of Illinois, Urbana, IL 61801.

Twenty-nine cultivars (00 to IV) were inoculated with 10 isolates of C. sojina (Cs) and seeds collected either of two ways: (i) from pods removed by hand from each of 16 cultivars or (ii) from threshed seeds of each of 13 cultivars. All seeds were assayed on blotters. Paired comparisons were made among percent defoliation and seed infection by C. kikuchii (Ck), Cs and Phomopsis sp. (Ph), 100-seed wt. (HSW), percent purple-stained seeds (Ps), percent SMV-mottled seeds and germination (G). The recovery of Cs varied from 0 to 91.6. There were correlations ($P = 0.0001$) between defoliation, %Cs, and a negative correlation for seed infection by Cs and Ck, Ph and Ps for (i) and HSW and SMV for (i,ii). The greatest reduction of HSW was due to Cs. No antagonism was noted between Cs and Ck. The 3 fungi do not survive well on seed surfaces after threshing.

CERCOSPORA SOJINA: A SET OF DIFFERENTIAL CULTIVARS FOR RACE IDENTIFICATION. J. T. Yorinori and J. B. Sinclair, Dept. of Plant Pathology, University of Illinois, Urbana, IL 61801.

C. sojina (frogeye leafspot of soybean) is highly variable in pathogenicity, colony characteristics, conidium size and number of septa/conidium (3 to 13), and among isolates from different regions and cultivars. Cultivars resistant in the USA are susceptible in other countries. Disease scoring methods in greenhouse inoculations are inconsistent with field evaluations, therefore 66 cultivars (00 to IX) were tested in the field with race 2 and with 9 new isolates. Two disease rating scales were used based on: type and number of lesions on a scale of 0 to 5, where 0 to 2 = resistant, 3 = intermediate and 4 to 5 = susceptible; and defoliation, where 0 to 5 = res., 6 to 9 = interm. and 10+ = susc. The differentials based on lesion type and defoliation are: Bienville, Blackhawk, Bragg, Capital, Comet, Davis, Dorman, Flambeau, Hampton, Hood, Lee, Mandarin (Ottawa), Patoka, Roanoke, Tanner and Wabash. The 9 isolates were identified as 7 new races, 5 to 11.

TECHNIQUES FOR THE DETERMINATION OF RESISTANCE IN *PHASEOLUS VULGARIS* L. TO *XANTHOMONAS*. Mildred Zapata, G. F. Freytag and R. E. Wilkinson, Dept. of Crop Protection, Univ. of P.R., MITA/USDA/SEA-AR, Mayaguez, Puerto Rico 00708, and Cornell Univ., Ithaca, New York 14850.

Strains of *Xanthomonas* isolated from *Phaseolus vulgaris*, *P. coccineus*, *Vigna unguiculata* and *Glycine max*, were used to inoculate primary and trifoliate leaves of bean plants in vegetative and reproductive stages, and detached trifoliate leaves and pods. Spray infiltration of leaves was as effective as the pin-cushion method. The latter provides more infection sites with symptoms similar to those in the field and no transmission of other diseases. Inoculation at the vegetative stage was less reliable than at the reproductive stage. *X. phaseoli* and *X. vignicola*, but not *Xp (ex coccineus)* and *Xp fuscans* induced symptoms during the reproductive stage only. Results from detached leaves were unreliable. The needle scratch method on pods was uniform and rapid. Some Cornell lines gave a uniform resistance reaction at all stages.

CALLUS FORMATION ON BEAN PODS (*PHASEOLUS VULGARIS* L.) AS A RESPONSE TO INOCULATION WITH SEVERAL STRAINS OF *XANTHOMONAS PHASEOLI* (E. F. Smith) Dowson. Mildred Zapata, Dept. of Crop Protection, Univ. of P.R., and MITA/USDA/SEA-AR, Mayaguez, Puerto Rico 00708.

An erupting mass of spongy callous tissue was observed in the wound area on pods of some lines of *P. vulgaris* as a response to inoculation, with the strains *X. phaseoli* #303, *X. phaseoli fuscans* #144 and two strains of *X. phaseoli* #866 and #820 (from *P. coccineus*). Inoculation was made by depositing a 0.01 drop of a bacterial suspension (10^7 cells) on each pod and then scratching the surface with a dissecting needle. No callus was formed on pods inoculated with *X. vignicola* and *X. phaseoli sojense*. Formation and size of callus appear to be related to the bacterial strain, but not to the susceptibility expressed as watersoaking. Bean lines could be classified into five groups according to their differential response in producing callus in the presence of these strains. These bean lines could be used as an aid for differentiation of *X. phaseoli* strains.

PHASEOLUS GERMPLASM RESISTANT TO SIX STRAINS OF *XANTHOMAS* IN PUERTO RICO. Mildred Zapata and G. F. Freytag, Dept. of Crop Protection, Univ. of P.R., and MITA/USDA/SEA-AR, Mayaguez, Puerto Rico 00708.

Lines of *Phaseolus coccineus* resistant to different strains of *Xanthomonas* were crossed with *P. vulgaris*. Field selection resulted in *P. vulgaris* lines showing high levels of resistance in the F_4-F_6 generations. Resistance was tested by inoculation of pods (needle scratch method) with six *Xanthomonas* strains, (*X. vignicola*, *X. phaseoli*, *X. phaseoli fuscans*, *X. phaseoli sojense*, and two strains of *X. phaseoli* from *P. coccineus*). Cultivars La Vega and W-117 (susceptible to these strains, but moderately resistant to Michigan strains) served as checks. Selection #235-1 of the interspecific cross, showed significantly higher resistance to all the strains. Inoculation with *X. phaseoli fuscans* and *X. phaseoli* (from *P. coccineus*), chosen for high virulence on a wide range of hosts, repeatedly demonstrated the high degree of resistance of this selection as compared to the local cultivars.