

## Research Note

### SURVEY ON FUNGAL DISEASES AFFECTING VEGETABLE CROPS IN SOUTHERN PUERTO RICO<sup>1,2</sup>

Evelyn Rosa-Márquez<sup>3</sup> and Guillermo J. Fornaris-Rullán<sup>4</sup>

J. Agric. Univ. P.R. 87(3-4):155-160 (2003)

Vegetable crops as a group are the fourth most important crop commodity in Puerto Rico, preceded by starchy crops, fruit crops and coffee commodities. Their production value for 2001-02 was close to \$27 million (Department of Agriculture, 2002). Although vegetable crops have a high economic impact on Puerto Rico's agriculture, during the past ten years no local research has evaluated fungal diseases affecting them.

In Puerto Rico, various fungal diseases causing damage to different vegetable crops have been reported. In cucurbits, including tropical pumpkin [*Cucurbita moschata* (Duchesne ex Lam.)], watermelon [*Citrullus lanatus* (Thunb.) Matsum. & Nak.], cucumber (*Cucumis sativus* L.) and melons (*Cucumis melo* L.), Ruiz-Giraldo (1986; 1992) mentioned the fungi *Pseudoperonospora cubensis* and *Erysiphe cichoracearum* causing downy mildew and powdery mildew, respectively, and *Dydimella bryoniae* (syn. *Mycosphaerella melonis*), producing gummy stem blight. He also reported target spot, caused by *Corynespora cassiicola*, mainly affecting cucumber. Also reported was the southern blight, caused by *Sclerotium rolfsii*, affecting eggplant (*Solanum melongena* L.), pepper (*Capsicum annuum* L.), tomato (*Lycopersicon esculentum* L.) and beans (*Phaseolus vulgaris* L.) in Puerto Rico (Ruiz-Giraldo, 1986). *Leveillula taurica* is known to cause powdery mildew in pepper (Negrón et al., 1991; Ruiz-Giraldo, 1986; Ruiz, 1990; Ruiz-Giraldo and Rodríguez, 1992), whereas *Phytophthora* sp. causes pepper blight (Ruiz-Giraldo, 1986; Ruiz, 1990). In tomatoes, *Phytophthora infestans* was reported causing late blight (Ruiz-Giraldo, 1986; 1990) and *Fulvia fulva* (syn. *Cladosporium fulvum*) causing leaf mold (Ruiz-Giraldo, 1990). Martin and Hepperly (1987) mentioned early blight, caused by *Alternaria solani*, as a limiting factor for successful year-round tomato production in Puerto Rico. In cabbage (*Brassica oleracea* L., Capitata Group), Monllor (1992) mentioned downy mildew (*Peronospora* sp.), leaf spot (*Alternaria* sp.), damping-off (*Pythium* sp. or *Rhizoctonia* sp.) and wire stem (*Rhizoctonia* sp.) as some of the most common diseases affecting this crop. Ruiz (1989) reported *Alternaria porri*, causing purple blotch, and *Peronospora destructor*, causing downy mildew, as two important fungal diseases in onion (*Allium cepa* L.) production. Fornaris et al. (1990) observed black mold (*Aspergillus niger*) in onion bulbs under storage. Reports published in *The Journal of Agriculture of the University of Puerto Rico* (JAUPR) before 1986 on fungal diseases affecting vegetable crops are the ones by Stevenson (1917), Matz (1921), Toro (1923), Nolla (1926, 1929), Álvarez-García (1946, 1947), and

<sup>1</sup>Manuscript submitted to Editorial Board 11 June 2003.

<sup>2</sup>This survey was supported in part by a special project AES-UPR (SP-348). The authors thank José A. Olivieri, María V. Maldonado, Nelson I. Rojas and José Montalvo, Extension Agents in the Vegetable Crops Program of the Agricultural Extension Service—UPR, for coordinating the initial farm visits and grower interviews.

<sup>3</sup>Assistant Plant Pathologist, Department of Crop Protection, Agricultural Experiment Station, Jardín Botánico Sur, 1193 Calle Guayacán, San Juan, PR 00926-1118.

<sup>4</sup>Associate Researcher, Department of Horticulture.

Alvárez-García et al. (1953). Of the vegetable crops grown by the farmers interviewed in this survey, no official reports were found in the JAUPR of fungal diseases affecting “ají dulce” pepper (*Capsicum chinense* Jacq.), broccoli (*Brassica oleracea* L., *Botrytis* Group) or coriander (*Coriandrum sativum* L.) in Puerto Rico.

The objectives of this two-year survey, conducted in fiscal years 2001 and 2002, were two-fold: to determine, through interviews with growers, which fungal diseases had been affecting commercial production of vegetable crops on the southern coast of Puerto Rico during the previous five years (1996 to 2000 growing seasons); and to identify under laboratory conditions the causal agents of fungal diseases found during the farm visits in this survey, including pathogenicity tests for the ones not previously reported on the island. This information could be useful for scientists or graduate students interested in conducting research on fungal diseases affecting vegetable crops grown on the south-southwest coast of Puerto Rico.

#### *Diseases affecting vegetable crops during the previous five years as reported by growers*

From July 2000 to June 2002, commercial vegetable crop growers were interviewed in the municipalities of Salinas, Santa Isabel, Juana Díaz, Guánica, Lajas and Cabo Rojo. The objective was to assess the incidence of fungal diseases encountered on their farms during the previous five years (1996 to 2000). Thirty-eight growers were interviewed: seven in Cabo Rojo, seven in Juana Díaz, 13 in the Guánica-Lajas area and 11 in the Salinas-Santa Isabel area. During the previous five years, 71% of them grew tropical pumpkin; 61%, “cubanelle” and “bell” peppers; 53%, watermelon; 26%, onion; 24%, eggplant; 21%, cucumber; 21%, tomato, among other vegetable crops. Table 1 presents the fungal diseases mentioned by the 38 growers as the ones affecting their vegetable crops from 1996 to 2000, the number of those who grew each of the vegetable crops, and the proportion of the ones who mentioned each disease as affecting the crop.

The growers mentioned all the different fungal diseases affecting their vegetable crops during the previous five years; they consider that fungal disease management for some crops is more difficult than for others. Many growers identified watermelon as the vegetable crop for which management of fungal diseases was the most difficult. A disease they described as a vine decline, or wilting, affects this crop late in the season as the fruits develop. Symptoms described were a water soaked brown lesion in the main stem with brown streaks on the side of the vine, leaf yellowing, wilting and eventually death of the plant. The first symptoms appeared most frequently two to three weeks before harvest. Severe reductions in yield were attributed to the disease. Eggplant was identified as the second crop with the most problems in terms of management of fungal diseases. The symptoms in the fruit were small spots prior to harvest or during brief storage. Affected fruit areas were at first soft and watery; later they became tough, dark, and turned brown. In a few days, the disease spread in all directions; finally, the fruit rotted. A bulb rot in onions was mentioned as another important disease management problem. Bulbs developed a semi-watery decay beginning in the neck area, which gradually moved downward. The onion later became water-soaked and translucent. These symptoms appeared mainly during the storage period.

#### *Fungi isolated and identified in the two-year survey farm visits*

When available, samples of plant tissue with visible symptoms were brought to the laboratory to be examined for the nature of the disease and the type of damage. Diagnosis was based primarily on the signs and symptoms expressed in the tissue along with the identification of the causal agent. Table 2 shows fungal diseases found in vegetable crop

TABLE 1.—Diseases mentioned by 38 farmers as those affecting their vegetable crops from 1996 to 2000.

<b>Tropical Pumpkin</b> (27 farmers) <sup>1</sup>	<b>Watermelon</b> (20 farmers)	<b>Cucumber</b> (8 farmers)	<b>Melons</b> (5 farmers)
Powdery Mildew (11/27) <sup>2</sup>	Gummy Stem Blight (13/20)	Powdery Mildew (2/8)	Downy Mildew (4/5)
Gummy Stem Blight (8/27)	Vine Decline or Wilting (9/20)	Anthracnose (1/8)	Powdery Mildew (4/5)
Vine Decline or Wilting (7/27)	Powdery Mildew (7/20)	Belly Rot (1/8)	Gummy Stem Blight (3/5)
Fruit Rot (5/27)	Downy Mildew (6/20)	Cercospora Leaf Spot (1/8)	Alternaria Leaf Spot (1/5)
Alternaria Leaf Spot (3/27)	Alternaria Leaf Spot (2/20)	Gummy Stem Blight (1/8)	Damping-Off (1/5)
Downy Mildew (3/27)	Anthracnose (2/20)	Vine Decline or Wilting (1/8)	
Anthracnose (2/27)	Damping-Off (2/20)		
Damping-Off (2/27)	Fruit Rot (1/20)		
<b>Peppers (“cubanelle” and “bell”)</b> (23 farmers)	<b>Eggplant</b> (9 farmers)	<b>Tomatoes</b> (8 farmers)	<b>“Aji Dulce” pepper</b> (6 farmers)
Powdery Mildew (19/23)	Fruit Rot (6/9)	Powdery Mildew (2/8)	Damping-Off (3/6)
Damping-Off (5/23)	Leaf Spot (1/9)	Fusarium Die Back (1/8)	Powdery Mildew (3/6)
Alternaria Leaf Spot (1/23)	Sooty Mold ( <i>fumagina</i> ) (1/9)	Fusarium Wilt-race 3 (1/8)	Sooty Mold ( <i>fumagina</i> ) (2/6)
Anthracnose (1/23)		Southern Blight (1/8)	Cercospora Leaf Spot (1/6)
Cercospora Leaf Spot (1/23)			
<b>Onion</b> (10 farmers)	<b>Coriander</b> (5 farmers)	<b>Cabbage</b> (4 farmers)	<b>Broccoli</b> (1 farmer)
Leaf Blight (7/10)	Damping-Off (4/5)	Damping-Off (2/4)	Downy Mildew (1/1)
Bulb Rot (3/10)		Leaf Spot (1/4)	

<sup>1</sup>Number of growers who grew the crop.

<sup>2</sup>Proportion of growers who mentioned the disease.

fields visited during the two-year survey. Pathogens were isolated from the margins of the diseased tissue. Surfaces were disinfected with 0.525% sodium hypochlorite. The samples were placed in a moist chamber or cut into small pieces, cultured in Potato Dextrose Agar (PDA) and incubated at 28° C for seven days. The associated fungus was identified by its morphology (Barnett and Hunter, 1998; Nelson et al., 1983).

Fungi isolated or identified from the stem of watermelons were *Phoma* sp., anamorph of *Dydimella bryoniae* (syn. *Mycosphaerella melonis*); *Pythium* sp.; and *Fusarium* spp. These microorganisms are considered pathogens and were related to the symptoms of the vine decline. None of them was found alone, neither in moist chambers nor in culture isolation. This association suggests the possibility that they can act simultaneously. *Phomopsis* has been previously identified as the causal agent of eggplant fruit rot. This disease is considered one of the most common and destructive in eggplant fruits. The first

TABLE 2.—*Fungi isolated and identified during the 2001 and 2002 survey from different plant tissues in vegetable crops growing on the southern coast of Puerto Rico.*

Vegetable Crop	Disease	Fungi	Plant tissue
Tropical Pumpkin	Alternaria Leaf Spot	<i>Alternaria</i> sp.	2 <sup>1</sup>
	Anthracnose and Fruit Rot	<i>Colletotrichum</i> sp.	2, 3
	Fruit Rot	<i>Phytophthora</i> sp.	3
	Gummy Stem Blight	<i>Phoma</i> sp.	1
	Leaf Spot	<i>Cladosporium</i> sp.	2
	Powdery Mildew	<i>Erysiphe cichoracearum</i> DC	2
	Vine Decline or Wilting	<i>Fusarium</i> sp.	1
Watermelon	Alternaria Leaf Spot	<i>Alternaria</i> sp.	2
	Gummy Stem Blight	<i>Phoma</i> sp.	1
	Powdery Mildew	<i>Erysiphe cichoracearum</i> DC	2
	Root Rot	<i>Pythium</i> sp.	4
Peppers (“cubanelle” and “bell”)	Vine Decline or Wilting	Various <sup>2</sup>	1
	Anthracnose	<i>Colletotrichum</i> sp.	2, 3
	Cercospora Leaf Spot	<i>Cercospora</i> sp.	2
	Damping-Off	<i>Fusarium</i> sp.	1, 4
	Leaf Spot	<i>Curvularia</i> sp.	2
Tomatoes	Powdery Mildew	<i>Leveillula taurica</i> G. Arnaud	2
	Alternaria Leaf Spot	<i>Alternaria</i> sp.	2
	Fusarium lesions	<i>Fusarium</i> sp.	1, 4
“Aji Dulce” pepper	Anthracnose	<i>Colletotrichum</i> sp.	2, 3
	Damping-Off	<i>Fusarium</i> sp.	1, 4
	Powdery Mildew	<i>Leveillula taurica</i> G. Arnaud	2
Onion	Bulb Rot	<i>Penicillium</i> sp.	3
	Leaf Blight	<i>Alternaria</i> sp.	2
	Root Rot	<i>Fusarium</i> sp.	4
Coriander	Damping-Off	<i>Fusarium</i> sp.	4
	Leaf Spot	<i>Alternaria</i> sp.	2
Cabbage	Leaf Spot	<i>Cladosporium</i> sp.	2

<sup>1</sup>Plant tissue: 1 = stem; 2 = leaves; 3 = fruits; 4 = roots.

<sup>2</sup>Various: complex of *Fusarium* sp., *Phoma* sp., *Pythium* sp.

known report of this disease in eggplant in Puerto Rico was by Stevenson and Rose (Nolla, 1929). The symptoms they described were similar to those we observed. Onion plant samples were obtained a few days before harvest and *Penicillium* sp. was identified, causing bulb rot; *Alternaria* sp., causing leaf blight; and *Fusarium* sp., causing root rot.

In tropical pumpkin, a soft fruit rot was observed. The initial symptoms were water-soaked or depressed spots. The side of the fruit in contact with the ground was affected first, but symptoms may also develop on the upper side. Under moist conditions, the fungus produces a white yeast-like growth that contains many sporangia. *Phytophthora* sp. was identified as the causal pathogen of this tropical pumpkin fruit rot. A pathogenicity test confirmed this finding. After inoculation, the initial symptoms were water-soaked or depressed spots; later on, that side of the fruit produced, under high humidity conditions,

a white yeastlike growth that contained many sporangia as seen in the field. Apparently, this is the first report in Puerto Rico of a disease in tropical pumpkin fruits caused by *Phytophthora*. This is also the first time that *Colletotrichum* sp., *Fusarium* sp. and *Leveillula taurica* have been isolated in "Ají Dulce" pepper, and that *Fusarium* sp. and *Alternaria* sp. have been isolated in coriander.

Further work should be conducted on the fungal diseases identified as the ones causing the most problems, such as watermelon vine decline, pumpkin fruit rot, onion bulb decay and eggplant fruit rot. Research on these diseases should be done since there is a real potential for yield and quality improvement in many of the vegetable crops if the incidence and damage is reduced. This research should take place as part of the development of an integrated disease management program.

#### LITERATURE CITED

- Álvarez-García, L. A., 1946. The control of *Rhizoctonia* damping-off of the pepper and eggplant in Puerto Rico. *J. Agric. Univ. P.R.* 30(2):69-96.
- Álvarez-García, L. A., 1947. A new specie of *Leptosphaeria* causing leaf blight of common garden Asparagus in Puerto Rico. *J. Agric. Univ. P.R.* 47(1):56.
- Álvarez-García, L. A., J. Adsuar, J. P. Rodríguez, A. C. Miret, F. Arostegui, R. Olivencia and I. Rochet, 1953. Fungicidal control of early and late blight of the potato in Puerto Rico. *J. Agric. Univ. P.R.* 37(4):288-97.
- Barnett, H. L. and B. Hunter, 1998. Illustrated Genera of Imperfect Fungi. Fourth Edition. APS Press, St. Paul, MN. 218 pp.
- Departamento de Agricultura, 2002. Ingreso bruto agrícola 2001/02. Estado Libre Asociado de Puerto Rico. Oficina de Estadísticas Agrícolas. Santurce, PR.
- Fornaris, G. J., E. Caraballo, R. Guadalupe, and E. Recio de Hernández, 1990. Storage tolerance of five short-day onion cultivars during a 12-week period. *J. Agric. Univ. P.R.* 74(3):293-98.
- Martin, F. W. and P. Hepperly, 1987. Sources of resistance to early blight, *Alternaria solani*, and transfer to tomato, *Lycopersicon esculentum*. *J. Agric. Univ. P.R.* 71(1):85-95.
- Matz, J., 1921. The Rhizoctonias of Porto Rico. *J. Depart. Agric. P.R.* 5(1):5-31.
- Monllor, A. C., 1992. Enfermedades comunes y método de control en repollo. *En: Foro Técnico: Cultivo y producción de repollo.* 14 de junio de 1992. Estación Experimental Agrícola, Barranquitas, PR. pp. 17-20.
- Negrón, J. A., R. Rodríguez and L. Avilés, 1991. Fungicide evaluation for control of powdery mildew, *Leveillula taurica* (Lev.) Arn., of peppers in Puerto Rico. *J. Agric. Univ. P.R.* 75(2):119-123.
- Nelson, P. E., T. A. Toussoun and W. F. O. Marasas. 1983. *Fusarium* species: An Illustrated Manual for Identification. The Pennsylvania State University Press. 193 pp.
- Nolla, J. A. B., 1929. The eggplant blight and fruit rot in Porto Rico. *J. Depart. Agric. P.R.* 13(1):35-57.
- Nolla, J. A. B., 1926. Onion-leaf anthracnose. *J. Depart. Agric. P.R.* 10(3-4):255-259.
- Ruiz, H., 1989. Control de malezas, insectos y enfermedades en siembras de cebolla. *En: Foro Técnico: Cultivo y producción de cebolla.* 14 de septiembre de 1989. Estación Experimental Agrícola, Juana Díaz, PR. pp. 4-5.
- Ruiz, H., 1990. Enfermedades del pimiento y métodos de control. *En: Foro Técnico: Cultivo, producción y elaboración del pimiento.* 16 de marzo de 1990. Estación Experimental Agrícola, Lajas, PR. pp. 82-87.
- Ruiz-Giraldo, H., 1992. Enfermedades más comunes en cucurbitáceas en Puerto Rico. *En: Foro Técnico: El cultivo de las cucurbitáceas.* 26 de junio de 1992. Estación Experimental Agrícola, Lajas, PR. pp. 52-53.

- Ruiz-Giraldo, H. and R. del P. Rodríguez, 1992. Añublo polvoriento del pimiento en Puerto Rico causado por *Leveillula taurica* (Lev.) Arn. *J. Agric. Univ. P.R.* 76(1):29-32.
- Ruiz-Giraldo, H., 1990. Algunas enfermedades del tomate. *En: Foro Técnico: Cultivo, producción y elaboración de tomate.* 27 de junio de 1990. Estación Experimental Agrícola, Juana Díaz, PR. pp. 28-30
- Ruiz-Giraldo, H., 1986. Enfermedades de las hortalizas. *En: Identificación y manejo de plagas en las hortalizas.* Servicio de Extensión Agrícola, Universidad de Puerto Rico. pp. 29-37.
- Stevenson, J. A., 1917. Diseases of vegetable and garden crops. *J. Depart. Agric. P.R.* 1(2):93-117.
- Toro, R. A., 1923. Una enfermedad importante de las cebollas en Puerto Rico. Gobierno de Puerto Rico, Departamento de Agricultura y Trabajo. Estación Experimental Agrícola Insular. Circular No. 71. pp. 3-6.