

## IDENTIFICATION AND INCIDENCE OF FUSARIUM STEM ROT IN GREENHOUSE PEPPERS IN SOUTH FLORIDA

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**Abstract.** A stem rot of greenhouse grown sweet peppers previously unreported in the United States was identified in South Florida. The disease causes black lesions on the stem and can result in wilting of the plants above the lesion. Plants of 3 cultivars in the commercial greenhouse were surveyed twice to evaluate disease spread, disease severity and location of lesions on the stem. The percent of visibly infected plants increased over the period March-June, 1999, as did the rate of infection. There was a higher percentage of plants with wilt symptoms and more plants were infected at harvesting wounds at the later survey. Apparent differences in susceptibility in the greenhouse were not supported by a controlled inoculation study.

### Introduction

Hydroponic greenhouse production of sweet peppers is a well established and growing industry in South Florida. Plants are in the greenhouse from approximately October until June and the long season makes disease problems particularly costly to producers. A stem rot on pepper previously unreported in the United States was found in a South Florida greenhouse in March 1999. Black lesions occurred at nodes where the plant was pruned or fruit was harvested. Tissues above the lesion appeared normal until the lesion girdled the stem, at which point the tissues above the lesion wilted and died. The morphology of the sexual stage was used to identify the organism as *Nectria haematococca* Berk. & Broome (anamorph *Fusarium solani* (Mart.) Sacc.). The disease has been previously reported in greenhouse peppers in Canada in 1990 (Jarvis et al., 1994) and in the United Kingdom in 1992 (Fletcher, 1994).

This report describes the initial work done to further describe the disease and survey its extent in the greenhouse where it was identified. The objective of the surveys was to determine the severity of the disease and judge the rate of disease development and spread over time.

### Materials and Methods

The symptoms were identified on peppers grown in a multi-bay, fiberglass and plastic film greenhouse with fan and

pad evaporative cooling. All cultivars ('Kelvin' (yellow), 'Cubico' (red) and 'Grizzly' (orange)) showed symptoms. Seeds were started in rockwool cubes and transplanted on October 9, 1998, at 4-5 weeks, into bags of perlite. There were 5 plants per 3-4' bag, with an emitter for each plant for water and fertilization. Within a bay, there were 36 rows with 100 bags per row. Each row was divided by a central walkway. Plants were pruned to 2 stems at 4-5 weeks after transplanting and stems were supported on strings.

The disease was identified from stem sections taken from the edge of lesions and cultured on ½ strength Difco potato dextrose agar. Two single spore isolates obtained from different plants were used to satisfy Koch's postulates. Five 4-week-old plants of 'Kelvin' were inoculated with each isolate by inserting a 4-mm agar block of the pathogen into the stem at approximately the third node. Five plants of the same cultivar were inoculated with fungus-free agar as controls. Within 1 week, black lesions similar to those seen in the commercial greenhouse appeared on all inoculated plants. One plant showed wilting symptoms above the inoculation site. The control plants remained healthy. The re-isolated fungus had the same morphology as that used for the inoculations.

Disease surveys were conducted May 15-16 and June 29, 1999. Plants to be surveyed were chosen randomly by location in the greenhouse bay by half row and bag number within that half row. At each location, 6 consecutive plants, 3 in each of 2 adjacent bags, were evaluated to examine plant-to-plant spread. The greenhouse bay chosen for the survey was that identified as having the highest incidence of the disease. In order to include the third cultivar, 'Grizzly', randomly chosen plants in a second bay were included in the survey. There were 293 plants evaluated in the May survey and 168 plants examined in the June survey. Data collected were a rating of disease severity based on lesion size and wilting and an indication of the location of the lesion on the plant (Table 1).

Initial survey data suggested differences in the percent of diseased plants per cultivar so 3 cultivars were evaluated in a controlled inoculation test. Cultivars used were 'Kelvin', 'Cubico' and 'Triple 4' as seed of 'Grizzly' were not available. 'Triple 4' is a greenhouse cultivar also grown commercially in South Florida. The plants were inoculated, as previously described, using 3 single spore isolates, 5 plants of each cultivar/isolate treatment combination and 4 control plants of each cultivar. Disease rating was measured 2 weeks after inoc-

Table 1. Rating scales for disease severity and location of lesions for survey of *Fusarium* stem rot in greenhouse peppers.

Severity of disease	
1	no symptoms
2	lesion covering less than ½ circumference of stem
3	lesion covering more than ½ circumference of stem
4	plant wilted
Location of lesion	
1	base (up to and including site of pruning)
2	above base (above site of pruning)

ulation as the product of the length of the lesion and the width of the lesion as percent of stem circumference.

## Results and Discussion

At the initial examination of plants in March 1999 when the disease was first reported, approximately 100 plants of the cultivar 'Kelvin' were evaluated. Ten to fifteen percent of the plants sampled had disease symptoms. In May 1999, 20% of the sampled plants showed symptoms and in June, 39% of the plants evaluated were visibly infected. This may have been the result of higher air temperatures or the increase in the number of open wounds as harvest progressed. When the results are broken out by severity of disease and location of lesions (Table 2), it is apparent that not only the rate of infection increased but also the severity of the disease. Also, the increased number of lesions which occurred above the base of the plant suggests that harvesting wounds offered additional sites of infection as time went on. The surveys may underestimate the percent of diseased plants. As the disease progressed, the greenhouse managers started to remove diseased plants as they showed wilting, to control disease spread. Missing plants were not included in the survey.

Results for 'Kelvin' and 'Cubico' were blocked by half row to see if there were variations in the amount of disease by location in the greenhouse. On both dates, there were more visibly infected plants near the fans than on the other side of the greenhouse bay. This may indicate the initial site of infection or be related to temperature or humidity variations in the greenhouse.

Perhaps as a consequence of location in the greenhouse, more plants of 'Kelvin' than of the other 2 cultivars showed

Table 2. Survey results for severity and location of lesions of Fusarium stem rot in greenhouse peppers.

Severity of disease (% plants)	Survey 1 (5/15/99)	Survey 2 (6/29/99)
2	10	10
3	2	4
4	8	25
<u>Location of lesion (% plants)</u>		
1	12	13
2	8	26

Table 3. Percent of pepper plants showing Fusarium stem rot by cultivar in greenhouse surveys.

Cultivar	Survey 1 (5/15/99)	Survey 2 (6/29/99)
Kelvin	34	62
Cubico	14	40
Grizzly	2	10

Table 4. Severity of Fusarium stem rot on greenhouse peppers by cultivar under controlled inoculation.

Cultivar	Disease rating <sup>a</sup>
Kelvin	0.6
Cubico	0.8
Triple 4	0.6

<sup>a</sup>Disease rating is length  $\times$  width of lesion. All inoculated plants had lesions.

disease symptoms at both survey dates (Table 3). Rows of 'Kelvin' were closer to the fans in the bay with the greatest incidence of disease and 'Grizzly' was grown in a different greenhouse bay with less disease. In order to determine if there were differences in susceptibility to the disease, 'Kelvin', 'Cubico' and 'Triple 4' were evaluated with controlled inoculations. All inoculated plants developed lesions, while no control plants showed symptoms. Although the cultivars varied somewhat in disease severity, there is not a clear indication that any resistance to Fusarium stem rot exists in the cultivars tested (Table 4).

No yield data were collected during the surveys. Certainly once the plants wilted, no more fruit were harvested. As 25% of the plants in the second survey showed wilting symptoms, the fruit yield must have been dramatically affected. We saw no fruit symptoms on plants with lesions or with wilting, although both previous reports included descriptions of fruit rot symptoms (Jarvis et al., 1994; Fletcher, 1994).

## Literature Cited

- Fletcher, J. T. 1994. Fusarium stem and fruit rot of sweet peppers in the glasshouse. *Plant Pathology* 43:225-227.  
 Jarvis, W. R., S. K. Khosla and S. D. Barrie. 1994. Fusarium stem and fruit rot of sweet pepper in Ontario greenhouses. *Canadian Plant Disease Survey* 74(2):131-134.