Rhizopus Soft Rot of Seedless Greenhouse Cucumbers

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ABSTRACT

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Rhizopus stolonifer incited soft rot of immature and mature seedless cucumbers in a greenhouse in south Florida. Infection of fruit appeared to follow establishment of the fungus on flowers. Spores of the pathogen were collected on plates of acid potato-dextrose agar exposed to air in the greenhouse. Fruit flies on affected fruit carried inoculum of the pathogen but did not effectively transmit the fungus to detached cucumber fruit. Field-grown Morgan melon were infected by the pathogen, but field-grown Poinsett and Marketmore cucumbers were not. Botran was the most effective fungicide in reducing infection.

The long, seedless, greenhouse-grown cucumber is a new crop to south Florida. A 2.8-ha commercial greenhouse planting was made in the fall of 1978 near Fort Pierce, Florida. In the spring of 1979, a soft rot was noticed on immature fruit in the greenhouse; a few mature fruit were also affected. The causal agent was identified as *Rhizopus stolonifer* (Ehrenb. ex Fr.) Lind. *R. stolonifer* has been reported as a postharvest problem on cucumbers and many other fruits and vegetables (2). No report of its being a problem on fruits on vines was found in a search of the literature. This report includes symptoms of the disease, possible means of spore dissemination, pathogenicity of the fungus, and effect of fungicides.

Water-soaked lesions on plastic-wrapped mature cucumbers ready for market were brought to our attention by the grower. No fungus growth was visible on the lesions. Lesions occurred primarily on the flower end of the fruit but also on the stem end and sometimes were scattered over the fruit. Small pieces of tissue from fruit surface-sterilized with 0.05% NaOCl and plated onto acidified potato-dextrose agar (APDA) consistently yielded colonies of *R. stolonifer*.

Fruits with their flower ends completely covered with fungus growth (Fig. 1) were scattered throughout the greenhouse. The fungus appeared to have entered the fruit via the attached flowers. A distinct margin occurred between infected and healthy tissue. The infected area directly behind the margin was water-soaked in appearance. When touched, the fruit usually broke into two pieces at the junction between healthy and diseased tissue. A grayish area, beginning about 1.5 cm behind the margin, contained mycelium, sporangiophores, and young

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The results presented in this paper are for information only and do not constitute or imply recommendation of any fungicide. Mention of a trade name or proprietary product does not imply approval of its use or of its use to the exclusion of other products that may be suitable.

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Fig. 1. A nearly mature cucumber fruit with symptoms of Rhizopus soft rot.

hyaline sporangia. Immediately behind this was a dark-purple, almost black growth, consisting of mycelium with mature dark sporangia. The appearance of the fungus in the diseased areas of the fruit was similar to that of *Choanephora cucurbitarum* (Berk. & Rav.) Thaxt. often observed by me on squash fruit. On young fruit, 5–10 cm long, the infected area increased at about 1.5 cm per 24 hr at 24–29 C.

Cucumber fruit of three different ages—young with fresh flowers (about 4–6 cm long), medium mature (about 20–25 cm long), and mature (about 35–45 cm long)—were harvested from the greenhouse. Wounds were made on fruits with sterilized dissecting needles. A disk of APDA with 48-hr-old *R. stolonifer* was applied to the wound. The fruit were incubated in a humidity chamber consisting of a plastic box with 500 ml of tap water and a wax-coated wire mesh screen that served as a platform for the fruit. The chambers were incubated in 21- and 30-C incubators and on the laboratory bench (24–29 C). There were four chambers and two fruit of each maturity level per chamber. Only one young fruit at 24–29 C and one medium-mature fruit at 30 C became infected. In a second test, one disk of inoculum per fruit (young, 5–6 cm) was placed on the flowers and 0.5, 2.5, and 5 cm from the flowers. Eight fruit were inoculated for each site. The fruit were randomly distributed in four humidity chambers. All fruit inoculated on the flowers developed typical soft rot lesions. Only two of eight fruit inoculated 0.5 cm from the flowers developed lesions after 72 hr of incubation at room temperature (24–29 C); the other fruits were unaffected. When young fruit with fresh flowers were sprayed with a 4×10^4 spore/ml of suspension, the fungus grew on the flowers before growing into the fruit. These data support the hypothesis that infection of fruit occurred via the flowers.

When flowers on young fruit of field-grown Morgan melon (a honeydew-type melon), greenhouse-grown long European cucumber cultivars Sandra, Vetumil, and Corona, and field-grown standard cucumber cultivars Poinsett and Marketmore were inoculated with disks of *R. stolonifer* on APDA, only the field-grown Morgan melon and the greenhouse-grown long green cucumbers were affected. Further tests are required to determine if the resistance of field-grown cucumbers to *R. stolonifer* was due to their being grown in the field or to some other factor.

R. stolonifer isolates from peach were used to inoculate flowers on young cucumber fruit and produced symptoms identical to those from cucumber. *Gilbertella persicaria* (Eddy) Hesseltine isolates from peach grew on the flowers but did not infect the fruit.

At the time the disease was discovered in the greenhouse, about 5.5 fruit per 100 plants were infected with *R. stolonifer*. Some discarded cucumbers on the floor (soil) of the greenhouse that were infected with *R. stolonifer* were pointed out to the grower, who removed them. The level of infected fruit, however, remained about the same over the next 5 mo. *R. stolonifer* grew out on APDA exposed to air in the greenhouse.

Fruit flies (*Drosophila melanogaster*) that congregated on the rotted areas of fruit were driven off during hand-labor and spraying operations and alighted on many plant parts, including young flowers. Flies chased from diseased fruit and alighting on uninfected plant parts were collected with a suction bottle, then transferred to 250-ml flasks of APDA. As a control, air from around plants was sampled with the collection bottle and the same procedure followed as if a fly were trapped. *R. stolonifer* consistently grew out in flasks with flies; as many as 20 distinct colonies of mycelia per flask were visible before the medium was overgrown by *R. stolonifer*. Of the control flasks, 40–60% were free from *R. stolonifer* and the others contained one to three colonies. When flies were placed in flasks with detached young fruit (with attached flower), only one of 12 fruit became infected. Further tests are required to determine if flies spread the disease under greenhouse conditions.

Ogawa et al (1) reported that *R. stolonifer* was sensitive to 2,6-dichloro-4-nitroaniline. This compound, as Botran 75W, was added to Difco PDA at 20 ppm active ingredient (a.i.). Tissue from 25 *Rhizopus*-infected fruits selected at random from throughout the greenhouse was placed on this medium and on PDA without fungicide. No *Rhizopus* grew on media with 20 ppm 2,6-dichloro-4-nitroaniline.

Young cucumber fruit with attached flowers were sprayed on the vine with 2,6-dichloro-4-nitroaniline (2,250 ppm a.i. Botran 75W), N-((trichloromethyl) thio)-4-cyclohexene-1,2-dicarboximide (1,500 pp a.i. captan, Orthocide 50), tetrachloro-isophthalonitrile (2,500 ppm a.i. Daconil 2787), a coordination product of zinc ion and manganese ethylene bisdithiocarbamate (2,400 ppm a.i. Dithane M-45 80W), and distilled water. The spray was allowed to dry. The fruit were harvested, then placed in humidity chambers and spray-inoculated with 5×10^4 spores/ml of suspension made from a 48-hr *R. stolonifer* on APDA culture. Botran 75W was the most effective in preventing development of fruit rot. Captan and Daconil 2787 were intermediate in effectiveness, and Dithane M-45 was no better than the control. Tests are required to determine the effectiveness of these compounds under greenhouse conditions.

LITERATURE CITED

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