Black Rot of Cranberry Caused by *Strasseria oxycocci*

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ABSTRACT

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An examination of cranberries from New Jersey revealed that *Strasseria oxycocci* can cause a storage rot indistinguishable from black rot caused by *Ceuthospora lunata*. *S. oxycocci* was isolated from 30% and *C. lunata* from 70% of black-rotted cranberries selected from New Jersey samples. The two fungi (*S. oxycocci* and *C. lunata*) were never isolated from the same cranberry. The pathogenicity of *S. oxycocci* was assessed by inoculating sound Searles cranberries with single-spore isolates. Symptoms identical to black rot caused by *C. lunata* developed within 3 wk. The berry tissues softened and turned black in 90% of the berries incubated at 12 C and 55% of the berries at 24 C. Only *S. oxycocci* was reisolated from these inoculated cranberries with black rot symptoms.

Black rot, a storage disease of cranberry (*Vaccinium macrocarpon* Ait.) fruit, has until recently been thought to be caused by one fungus, *Ceuthospora lunata* Shear. However, in fruit from New Jersey, *Strasseria oxycocci* Shear, instead of *C. lunata*, was isolated from a significant number showing black rot symptoms.

Black rot is readily recognized by the black color of the affected fruit. Early during disease development, the tissues of infected berries remain firm and slightly watery. The berries then turn black and gradually shrink, becoming wrinkled and hardened. Often pycnidia of *C. lunata* develop under the berry epidermis.

C. lunata was first described fruiting on dead cranberry leaves (2) and later was found associated with the diseased fruit (3). *S. oxycocci* was described fruiting on necrotic cranberry leaves (2,4) but has not been reported to infect the fruit.

The purpose of the present study was to investigate the role of *S. oxycocci* in black rot of cranberry. The importance of *S. oxycocci* as an incitant of black rot was determined by examining its natural incidence in field samples. The pathogenicity of *S. oxycocci* was tested in controlled inoculations. During the course of the study, pathologic and cultural characteristics of *S. oxycocci* and *C. lunata* were compared.

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MATERIALS AND METHODS

Isolations of fungi were made from fruit with black rot symptoms that developed in stored field samples of cranberries from the Rutgers Blueberry and Cranberry Research Center, Chatsworth, NJ, and from several Wisconsin marshes. Each berry was surface-sterilized by being dipped momentarily in 95% ethanol and shaken, and the ethanol was then immediately flamed off. A portion of epidermis was peeled back aseptically, and a small piece of underlying pulp tissue was excised and placed on a potato-dextrose agar slant. Cultures of fungi that grew from the tissues were incubated at 20 C for 3 wk and then at 4 C for 1 mo. This temperature regimen favored mycelial growth and also pycnidial production and sporulation of both *C. lunata* and *S. oxycocci*.

The pathogenicity of *S. oxycocci* isolates was tested by wound-inoculating sound cranberries of the Searles cultivar. The two cultures used were single-spore transfers from the original isolates. Before inoculation, the berries were surface-sterilized by being immersed for 5 min in 1% sodium hypochlorite in water containing 0.05% Tween 80 and then rinsed in sterile distilled water. Each berry was then injected with 0.05 ml of a suspension of inoculum containing 4×10^4 spores per milliliter using a 25-g (0.45 mm outside diam), 1-cc syringe. Forty cranberries were inoculated with each isolate of *S. oxycocci*. For controls, 32 berries were injected with sterile distilled water. Half of the berries in each treatment were incubated in sterile moist-chambers at 12 C and half at 24 C. After 3 wk of incubation, reisolations of the fungi were attempted from all the berries.

RESULTS

S. oxycocci was obtained from New Jersey cranberries but not from Wisconsin fruits. It was isolated from 38 of 125 (30.4%) of the naturally infected berries that showed symptoms of black rot. *C. lunata* was isolated from the remaining 87 berries (69.6%) from New Jersey. The two fungi were never found together in the same cranberry. Only *C. lunata* was isolated from Wisconsin black rot samples.

Both fungi have slightly curved to allantoid spores measuring $8-10 \times 3$ μm. *S. oxycocci* conidia (Fig. 1A) have large

Table 1. Percentage of infection of cranberries inoculated with *Strasseria oxycocci* and incubated at 12 and 24 C

Inoculum	Incubation temperature (C)	Berries infected with *S. oxycocci* (%)	Berries with symptoms (%)
Control	12	0	0
	24	0	0
Isolate A	12	87.5	82.5
	24	55.0	35.0
Isolate B	12	92.5	90.0
	24	60.0	30.0

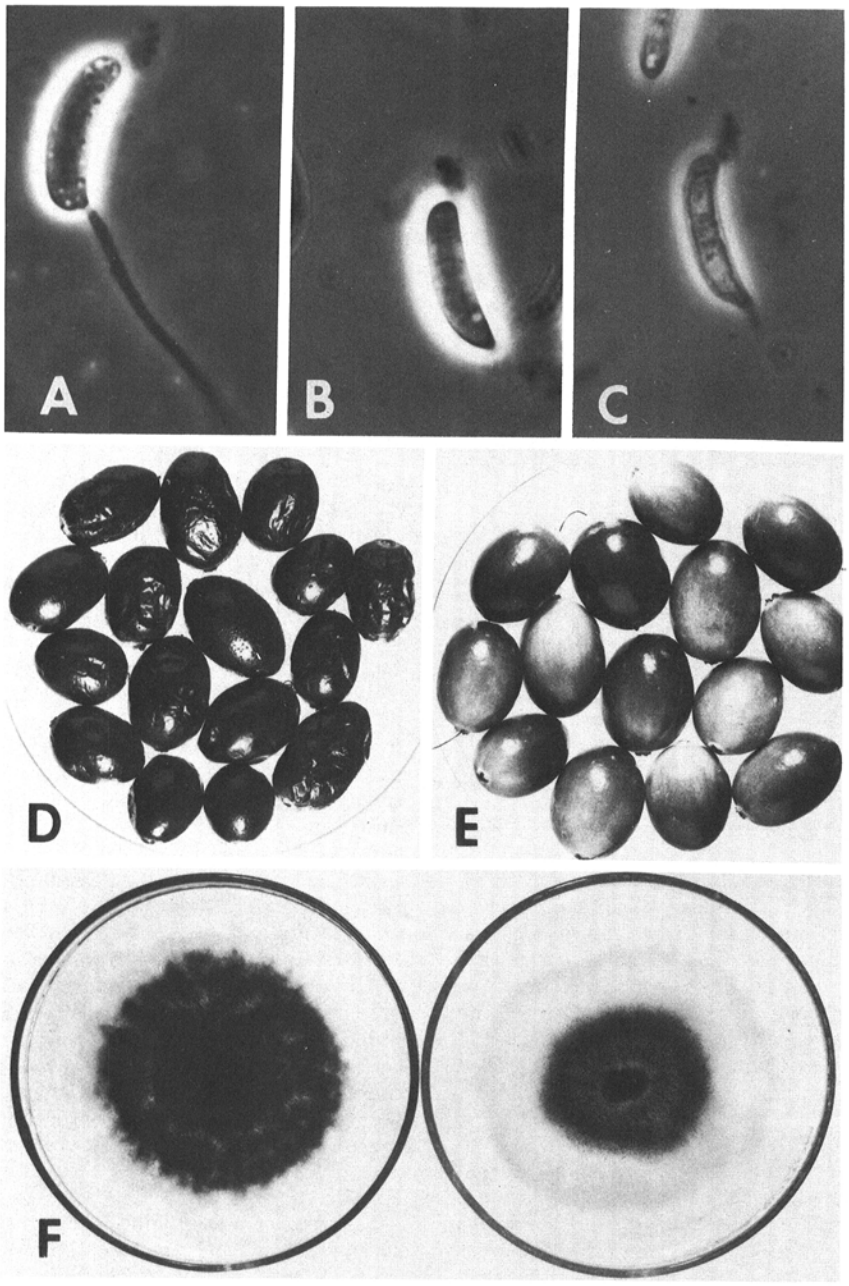

Fig. 1. (A) *Strasseria oxycocci* conidium showing the long basal appendage and the apical mucilaginous appendage (×1,875); **(B)** *Ceuthospora lunata* spore showing the apical mucilaginous appendage (×1,875); **(C)** *C. lunata* spore showing the apical mucilaginous appendage and the vestige of the basal appendage (×2,500); **(D)** cranberries with black rot caused by *S. oxycocci*; **(E)** sound cranberries; **(F)** 5 days' growth of *C. lunata* (left) and *S. oxycocci* (right) colonies on potato-dextrose agar.

basal appendages (6), whereas conidia of *C. lunata* (Fig. 1B) do not. However, spores of some isolates of *C. lunata* (Fig. 1C) appear to have a vestige of a basal appendage. The apical mucilaginous appendage that is characteristic of *C. lunata* conidia (7) was also found on the conidia of some isolates of *S. oxycocci*.

Colonies of *S. oxycocci* are lighter gray and slower growing than those of *C. lunata* (Fig. 1F). Both organisms have simple, or less frequently multiostiolate, pycnidia about 0.5 mm in diameter. *S. oxycocci* pycnidia tend to be more floccose than those of *C. lunata*.

Generally, cranberries inoculated with *S. oxycocci* developed typical black rot symptoms within 3 wk (Fig. 1D). Inoculations were more successful and symptom expression more pronounced when the berries were incubated at 12 C rather than at 24 C (Table 1). The fungus was reisolated from all fruit that developed black rot symptoms. At 24 C, many inoculated berries were asymptomatic, with softened tissues but without black pigment. Most asymptomatic fruits contained *S. oxycocci*, but *Physalospora malorum* Shear, *Alternaria* sp., or *Penicillium* sp. were isolated from some. None of these latter three fungi was ever associated with black rot symptoms.

DISCUSSION

The symptoms on cranberry fruit from New Jersey caused by *S. oxycocci* and *C. lunata* are indistinguishable. *S. oxycocci* may be partly responsible for the increase of black rot in recent years in East Coast cranberry marshes (5). *S. oxycocci* was not isolated from cranberry fruit from Wisconsin even though the fungus can occasionally be observed sporulating on necrotic cranberry leaves. As with some other diseases of cranberry (1), cultural and environmental conditions peculiar to Wisconsin may limit the prevalence of *S. oxycocci*. The distribution of *S. oxycocci* and the factors responsible for its importance in some cranberry-growing areas need to be examined further. Black rot control programs on the East Coast may have to be separately assessed for effectiveness against *S. oxycocci* and *C. lunata*.

Because some isolates of *S. oxycocci* and *C. lunata* have several macromorphological and micromorphological characteristics in common, there appears to be valid reason to question placing these species in separate genera. This work has shown that the two fungi are pathogenically similar. Both organisms also have pycnidia that are the same size and shape. Each species may, depending on the isolate, occasionally show similar key taxonomic characters of the other species, such as apical mucilaginous appendages and vestiges of basal appendages on conidia (6–8). The overlapping taxonomic characters of these two organisms warrant further investigation.

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