Fungi Associated With Blueberries Held at Various Storage Times and Temperatures

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ABSTRACT

Sixteen fungi, representing 15 genera plus one mycelial form, were isolated from fruit of the highbush blueberry varieties Weymouth, Bluecrop, and Jersey stored at several temperatures for various time periods. The predominant fungi found were the *Gloeosporium* stages of *Glomerella cingulata*, *Botrytis cinerea*, and *Alternaria tenuis*. As the harvest season progressed, *G. cingulata* was isolated more frequently, but decreasing numbers of fruit were colonized by *A. tenuis*. The best storage treatment was 4 days at 10 C.

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Additional Key Words: decay, mold development.

The extent of postharvest deterioration of blueberries by fungi depends on the preharvest conditions, inoculum potential, and storage. From the consumer's standpoint, a reduction in quality occurs whether an organism merely grows on the surface of the berry or causes decay.

The principal decay-producing fungi of berries are reported to be *Botrytis cinerea* Pers. ex Fr., the *Gloeosporium* stage of *Glomerella cingulata* (Ston.) Spauld. & Schrenk (1, 2, 4, 5), and *Rhizopus stolonifer* (Fr.) Lind. (2). Under certain conditions, a number of fungi can grow on blueberries even though decay may not occur. The primary locus is the stem-end scar. Little or no information is available on which organisms grow here and with what frequency. The following study was initiated to isolate and identify those fungi growing on berries held for varying time periods at different temperature levels.

MATERIALS AND METHODS.–Weymouth, Bluecrop, and Jersey varieties were selected to represent early, mid- and late-season highbush blueberries, respectively. Blueberries were picked from two principal growing areas of New Jersey and stored for 2, 4, and 6 days at room temperatures (∿ 27 C); 4,8, and 12 days at 10 C; and 2 days at 10 C followed by 2 days at room temperature and vice-versa. Data were taken on berries harvested during June, July, and August. Every berry from 6 pints of each variety and harvest was evaluated for storage mold.

Fungi were isolated by removing small bits of mycelium and/or spores from molding berries, and plating these on potato-dextrose agar. Over 90,000 blueberries were evaluated, and over 2,500 isolations made.

RESULTS AND DISCUSSION.–In general, the keeping quality of blueberries deteriorated with each successive harvest. The variety Weymouth exhibited poorer keeping qualities than did either Bluecrop or Jersey. The best storage treatment was 4 days at 10 C (Table I). As storage time increased, more mold was found regardless of temperature. These results are consistent with other studies (3). With Weymouth, comparable results were obtained when they were

TABLE 1. The effect of storage on mold development in Weymouth (W), Bluecrop (BC), and Jersey (J) blueberries

Variety and treatment		% Mold[a]			
		Harvests			
		I[b]	II	III	Season total
W	A[c]	2.1	4.6	9.4	4.6
	B	19.8	21.4	37.9	23.9
	C	46.9	53.1	72.0	58.7
	D	0.3	0.6	1.5	0.7
	E	2.0	7.8	8.7	5.8
	F	8.3	23.9	48.3	22.6
	G	3.1	8.5	25.2	9.8
	H	3.9	6.4	26.1	9.4
BC	A	2.9	3.7	1.9	3.0
	B	7.9	14.8	9.3	11.3
	C	19.8	20.5	29.2	22.1
	D	0.6	0.5	1.5	0.7
	E	3.3	3.8	11.0	5.1
	F	5.5	8.6	22.7	10.7
	G	3.4	4.8	8.7	5.2
	H	1.7	4.4	3.6	3.3
J	A	1.4	3.9	[d]	2.9
	B	7.2	7.5		7.4
	C	8.8	10.4		9.7
	D	0.8	1.8		1.3
	E	3.1	3.9		3.6
	F	4.0	2.6		3.2
	G	2.0	6.3		4.4
	H	1.5	1.6		1.6

[a] Average of 6 pints.

[b] I = June; II = July; III = August.

[c] A, B, C = 2, 4, and 6 days at room temperature (∿27 C); C); D, E, F = 4, 8, and 12 days at 10 C; G = 2 days at 10 C followed by 2 days at room temperature; H = 2 days at room temperature followed by 2 days at 10 C.

[d] A third harvest was not evaluated.

held at 10 C for 2 days followed by 2 days at room temperatures, or vice-versa. Bluecrop and Jersey developed less mold if held at 10 C after 2 days at room temperature.

Sixteen funti, representing 16 genera plus one mycelial form, were observed and/or isolated from molding berries (Table 2). One isolate was tentatively

TABLE 2. Fungi isolated from "moldy" Weymouth, Bluecrop, and Jersey blueberries held at 8 storage conditions

Fungi	% Frequency
Gloeosporium fructigenum	4.0
Botrytis cinerea	3.0
Alternaria tenuis	2.4
Saccharomyces sp.	0.8
Aspergillus niger	0.3
Cladosporium herbarum	0.3
Trichoderma sp.	0.3
Aspergillus sp.	<0.1
Cylindrocarpon-like	
Epicoccum sp.	
Fusarium sp.	
Nigrospora sp.	
Penicillium sp.	
Pullularia sp.	
Rhizopus stolonifer	
Mycelium	

identified as "Cylindrocarpon-like" pending positive identification. In order of frequency, the *Gloeosporium* stage of *Glomerella cingulata, Botrytis cinerea*, and *Alternaria tenuis* Auct. were the predominant organisms. An interesting relationship was observed between *Gloeosporium*, and *Botrytis* and *Alternaria*. During early season to midseason, the ratio of *Gloeosporium* and *Alternaria* remained relatively constant (Fig. 1). At about midseason, this ratio increased sharply, and by late season, the occurrence frequency of *Gloeosporium* was ∿45 times that of *Botrytis* or *Alternaria*. As the season progressed, the isolation frequency of *Alternaria* declined and that of *Gloeosporium* increased. These trends are consistent with field observations that *Gloeosporium* increases as the season progresses. On the other hand, the ratio of *Botrytis* to *Alternaria* showed essentially no change throughout the season (Fig. 1). *Alternaria* has been observed on New Jersey blueberries, but has not been considered an economic problem even though it has been reported to cause a fruit rot. Its frequency of occurrence in this study was unexpected, and we plan to evaluate its potential as a decay producer. With the exception of *Rhizopus*, the other fungi are considered relatively unimportant. However, *Aspergillus niger* and *Trichoderma* sp. can cause severe breakdown of the fruit when mechanical injury occurs.

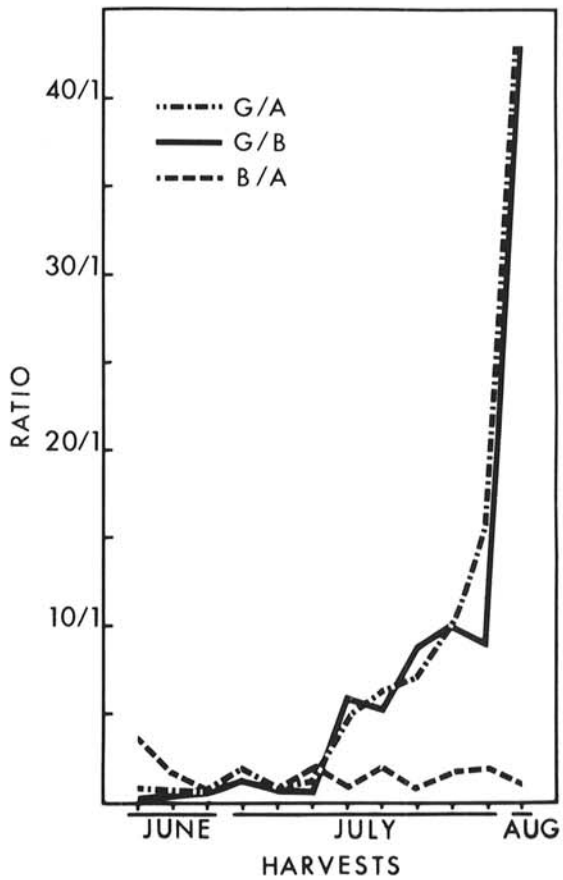

Fig. 1. Effect of harvest time on the relative occurrence of *Gloeosporium* to *Altarnaria* (G/A), *Gloeosporium* to *Botrytis* (G/B), and *Botrytis* to *Alternaria* (B/A) on highbush blueberry fruit.

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