DECAY OF WOOD BY THE DACRYMYCETALES

by

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ABSTRACT

Forty-one strains representing sixteen species in the Dacrymycetales were tested for their abilities to decay wood using the soil block test. Dacrymyces stillatus, D. capitatus, D. dictyosporus, Dacryopinax spathularia, Cerinomyces ceraceus and Calocera cornea and C. lutea caused considerable decay of wood. Dacrymyces palmatus, D. minor, D. novae-zelandiae and Calocera viscosa also decayed wood to a significant extent. Four distinct types of decay were noted; three types of brown-rot and one type of white-rot. The brown-rotting strains were unusual in that some degraded considerable amounts of lignin. Monokaryons of Dacryopinax spathularia showed a reduced capacity to decay wood, while those of Dacrymyces stillatus and D. palmatus did not decay wood. Types of rot associated with species in the Tremellales and Auriculariales thought to be saprobic on wood are presented based on herbarium specimens.

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INTRODUCTION

That lower basidiomycetes do not cause significant decay of wood has been a prevailing feeling among forest pathologists (Boyce 1961; Gilbertson 1980). Of approximately 2000 species of wood decay fungi believed to occur in North America (Gilbertson 1981), only eleven species within the heterobasidiomycetes have been suspected of being involved with decay of wood. Aporpium caryae (Schw.) Teixeira & Rogers (Macrae 1955), Exidia glandulosa Fr. (Muller & Loeffler 1971), Bourdotia eyrei Wakef., B. galzinii (Bres.) Bres. & Torr., Sebacina calcea (Pers.) Br., S. epigaea (B. & Br.) Bourd. & Galz. (Lindsey & Gilbertson 1978) are members of the Tremellales which have been observed in association with white-rot of hardwoods. Helicobasidium corticioides Bandoni, in the Auriculariales, has had its decay abilities confirmed in pure culture: it causes a brown pocket rot of softwoods (Davidson & Hinds 1958). The other species suspected of decaying wood are members of the Dacrymycetales.

The Dacrymycetales is an order containing a single family of approximately eighty species, all having bifurcate basidia. All species in the order grow on wood. Basidiocarps of most are gelatinous and contain yellowish or orange carotenoid pigments (Goodwin 1953; Hanna & Bulat 1953; Vail & Lilly 1968; Cze Czuga 1980). The taxonomy of

the group has been studied by McNabb (1964, 1965a-e, 1966, 1973), Kennedy (1956, 1958ab, 1964), Martin (1952), and Reid (1974).

Shields and Shih (1975) studied decay capabilities of three species in this order using a modified soil block test. Two strains of Calocera cornea tested caused a brown-rot of yellow birch, and 40% and 37.9% weight loss. One of the above strains caused a weight loss of 62.3% on red pine. Two strains of Dacrymyces stillatus caused a brown-rot of red pine, and 12.0% and 33.5% weight losses. Dacryomitra nuda caused a 3.5% weight loss in red pine.

Calocera viscosa has been reported to cause a heart rot in stumps of Douglas fir (Siepmann 1977, 1979) and European Larch (Pawsey 1971) in Europe.

This information suggests that members of the Dacrymycetales may be important in the decay of wood. There is also some practical benefit to studying the decay abilities of species within the order. Calocera cornea (Shields & Shih 1975); Dacrymyces palmatus (this study); D. stillatus (Buller 1922; Ramsbottom 1953; Reid 1974; this study); Dacryopinax spathularia (Duncan & Lombard 1965; this study) and Ditiola radicata (Harmsen 1954; Reid 1974) are all known from wood products in service.

This study focuses on three of these fungi: Dacrymyces palmatus, D. stillatus, and Dacryopinax spathularia. Isolates of twelve additional species in the order have

been screened for ability to decay wood.

MATERIALS AND METHODS

PRELIMINARY EXPERIMENTS

Growth of Dacrymyces stillatus KAS 2 and Dacryopinax spathularia UBC 6101 at various temperatures was determined by measuring growth on Nobles' malt agar (Appendix 1). Single 2 mm plugs of inoculum from growing agar cultures were placed on the edge of MA plates and incubated in the dark at 15, 20, 25 and 30°C, with three replicates at each temperature for each fungus. Radial growth was measured from the edge of inoculum block to the growing point of the colony after 1 and 2 weeks.

Comparison of growth of the above strains was made in two liquid broth media considered appropriate for soil block test inoculation media. These were glucose malt broth (GM) and a defined balanced medium (BM) (Appendix 1). Two hundred and fifty ml erlenmeyer flasks containing 50 ml of GM were inoculated with agar plugs of the fungi and incubated for three weeks at 20°C for use as inoculum. Inocula were homogenized for 30 seconds at top speed in a Waring blender, and 1.0 ml of inoculum was transferred to 125 ml erlenmeyer flasks containing 20 ml of either GM or BM with a sterile serological pipette and a propipette. Flasks were capped with four layers of paper towels held in

place with elastic bands. For each fungus, 18 flasks of each medium were inoculated. D. stillatus KAS 2 was incubated at 20°C and D. spathularia UBC 6101 at 25°C. Cultures were stationary, in a 12 hour light/12 hour dark regime. At weekly intervals, three flasks of each fungus in each medium were harvested. Prewashed Whatman qualitative #1 50 mm filter papers of known weight were placed in 50 mm Buchner funnels, and wetted with distilled water. Mycelium from individual flasks was filtered through the funnel using an aspirator. The filter papers with mycelium were placed in individual 5 cm plastic or glass petri dishes and dried overnight in a freeze drier before weighing.

DECAY STUDIES

Preparation of wood

Trees were harvested at Maple Ridge, Blue Mountain, B.C., on June 1, 1981. Trees selected were of 9-12" dbh, a suitable diameter for obtaining 1-2" of sapwood. One tree of each of the following species was felled: Alnus rubra Bong. (red alder), Acer macrophyllum Pursh (big leaf maple), Thuja plicata Donn. (western red cedar), Pseudotsuga menziesii (Mirbel) Franco (Douglas fir), and Tsuga heterophylla (Raf.) Sarg. (western hemlock). The

maple tree selected had a several cm core of heart rot, but the sap wood was sound. The other trees were healthy. Species selected are common substrata for species of Dacrymycetales (Appendix 2). After felling, branches were removed and logs cut into a manageable size. Logs were transported to the workshop, cut into 60 cm lengths and quarter sawn. Boards 30 mm thick were cut from the quarters such that the grain was approximately parallel to the tangential surface of the board. These boards were debarked and kiln dried at 120°C for four days, then at 130°C for one day, resulting in final moisture contents of 8 to 22%.

Dried boards were planed to 19 mm, and 19 mm wide strips of sapwood were cut. The resulting strips were cut into 19 mm cubes. Cubes of heartwood of western red cedar were prepared in an identical manner. Cubes with knots or discolorations were discarded.

Feeder strips were prepared by planing dried boards to 25 mm and cutting 4.5 mm wide strips from the sapwood. These strips were cut into 50 mm lengths. Feeder strips of western red cedar heartwood were prepared in an identical manner. Feeder strips containing knots or discolorations were discarded.

Blocks and feeder strips of Pinus ponderosa Dougl. (ponderosa pine) sapwood were supplied by Forintek Canada, Corp. Vancouver, from their stock collection.

Before use in tests, blocks were sorted according to weight, so that blocks used in a particular test would be of similar mass. An attempt was made to select blocks in which the grain was nearly parallel to the tangential face. Blocks were numbered and coded with pencil, dried overnight in a 105°C forced air oven, cooled in a desiccator, and weighed prior to use in tests.

Fungal cultures

Whenever possible, cultures derived from freshly collected basidiocarps were used. If freshly collected basidiocarps were not available, recently collected specimens were revived in distilled water. Portions of sporulating basidiocarps were suspended over MYPT agar (Appendix 1) in deep petri dishes using masking tape. Sporulation was allowed to occur for several hours at a temperature similar to that at which the fungus was collected. After spore germination, a block of agar containing germinated spores was transferred to MYP agar plates (Appendix 1). Cultures of species not found locally and for which I was unable to obtain recently collected specimens, were obtained from established culture collections. Monosporous cultures of Dacryopinax spathularia were isolated from a dried collection. Basidiocarps were revived and suspended over a sterile

microscope slide for several hours, then ejected spores aseptically scraped into 10 ml of sterile water in a screw cap test tube. Loops of the spore suspension were streaked onto MYPT plates. Individual germinating basidiospores were removed from the plate using a sterile needle under the dissecting microscope, and placed on MYP plates. Stock cultures were maintained on MYP slants.

The following cultures of Dacrymycetaceous fungi were tested for wood decay ability using the soil block test method. Collection data for these isolates are included in Appendix 3. Cultures marked with an asterisk were also grown on a vermiculite-sand mixture.

On alder, maple, douglas fir, western red cedar sapwood and heartwood.

Dacrymyces palmatus (Schw.) Bres.- UBC 6170

Dacrymyces stillatus Nees:Fr.- UBC 6146, UBC 6147

Dacryopinax spathularia (Schw.) Martin- UBC 6101*,
UBC 6126*, UBC 6171

On alder only:

Calocera cornea Batsch:Fr.- UBC 6151, UBC 6152,
UBC 6153, UBC 6169

Cerinomyces ceraceus Ginns- UBC 6160*

Cerinomyces crustilinus (Bourd. & Galz.) Martin-
UBC 6108

Dacrymyces capitatus Schw.- UBC 6125*, UBC 6144

Dacrymyces novae-zelandiae McNabb- UBC 6167

On Douglas fir only:

Calocera lutea (Massee) McNabb- UBC 6150

Calocera viscosa (Pers.:Fr.) Fr.- UBC 6154, UBC 6168

Cerinomyces canadensis (Jacks. & Martin) Martin-
UBC 6094

Dacrymyces minutus (L. Olive) McNabb- UBC 6175

Dacrymyces palmatus (Schw.) Bres.- UBC 6120*,
UBC 6148*, UBC 6166*, UBC 6176, KAS 17, Wells
A-50-1, -4, -8

Dacryopinax spathularia (Schw.) Martin- UBC
6171 monosporous 2, 4, 7

Heterotextus luteus (Bres.) McNabb- UBC 6125*

On ponderosa pine only:

Calocera cornea Batsch:Fr- UBC 6152*

Dacrymyces dictyosporus Martin- UBC 6121*, UBC 6149

Dacrymyces punctiformis Neuh.- UBC 6124*

Dacrymyces stillatus Nees:Fr.- KAS 2

One cedar sapwood only:

Dacrymyces minor Pk.- UBC 6177

Dacrymyces stillatus Nees:Fr.- UBC 6145, Wells

A-228-2, -7, -11

For purposes of comparison, four cultures of wood rotting Aphyllophorales, obtained from Forintek, were tested for wood decay ability in the same conditions.

On alder:

Coriolus versicolor (L.:Fr.) Quel.- 105E

Phanerochaete chrysosporium Burds.- ME 461

On ponderosa pine:

Poria placenta (Fr.) Cooke- 120F

Poria subvermispora Pilat- L6332

Soil block test

Wood was decayed by the test fungi following the American Society for Testing Materials method (1976), with some modifications. In this method, 16 ounce jars half filled with soil of a known moisture and moisture holding capacity, with 25x50x4.5 mm feeder strips of sapwood supported by the soil, are inoculated with a pure culture of fungus. After three weeks incubation, sterile 19 mm cubes of wood are placed on the feeder strips. The jars are incubated a further 12 weeks before analysis of the blocks. The details of the method and the modifications

adopted are described below.

Sixteen ounce Universal glass jars with accompanying 63 mm lids were supplied by Ampak, Ltd., Richmond, B.C. Culture lids were prepared according to the method of Smith (1978). A 5 mm. diameter hole was punched in the approximate centre of each lid using a mechanical press fitted with a 5 mm die. Gelman GA-8 filters, 25 mm diam. with 0.2 μ m pores, were supplied by Western Scientific Services Ltd. After wiping the inner surface of the lids with acetone to remove grease, the filters were glued over the holes to the inside of the lids using 24 hour epoxy glue. The glue was allowed to harden at least one week before the lids were used. Prior to use, lids were wrapped in lots of ten in brown paper and autoclaved at 121°C and 15 psi for 20-30 minutes on the dry or wet cycle.

The standard matrix used for all fungi was an undefined medium consisting of soil, sand and water. Soil was supplied by the Dept. of Horticultural Science and had been steam sterilized prior to being made available. Soil was analysed by the Soil Testing Laboratory of the British Columbia Ministry of Agriculture and Food, Kelowna, B.C. The soil was of "coarse" texture, had an initial moisture content of 16.5%, a pH of 6.0-6.1, available nutrient concentrations of 166 ppm NO_3 , 292 ppm P, 447 ppm K, 2285 ppm Ca, and 319 ppm Mg, and a salt conductance of 2.68

Mmhos./cm. Soil was sifted through a 1 cm screen prior to use. Medium washed river sand was purchased from Target Concrete Products, Ltd., Burnaby, B.C. The undefined medium consisted of 1 part sand and 3 parts soil, enough to half fill the jars, and 40 ml of water per jar. This mixture had a moisture holding capacity of 36%, between the 20-40% limits allowed by the ASTM standard.

The culture vessels were assembled by filling clean jars with the appropriate amount of soil and sand, homogenizing the matrix by hand shaking, adding the appropriate amount of water, and tapping this mixture down gently with a wooden plunger. One feeder strip of sapwood was placed firmly on the surface of the matrix, and the jars loosely sealed with ordinary metal lids. The jars were autoclaved for 1 hour at 121°C and 15 psi on the wet cycle and allowed to cool in a laminar flow hood. Following cooling, the metal lids were aseptically replaced with sterile culture lids. Five jars of each species were inoculated for each species of wood to be decayed.

Two different types of inocula were used in the course of the study. In large experiments, blocks were inoculated with blended mycelium from 3-6 week old liquid broth cultures grown in BM. Jars in screen experiments were inoculated with agar cultures blended with sterile water. Cultures were blended for 30 seconds in sterile Waring

blenders, or for 10 seconds in sterile Sorval blenders. All jars received 1.0 ml of inoculum, delivered with sterilized serological pipettes and a propipette. The inoculation method of the ASTM standard, in which small blocks of agar cultures are placed onto the feeder strips, was abandoned after preliminary experiments due to slow growth.

After inoculation, jars were incubated at 25°C in the dark for 3 weeks to allow fungal growth to become established. Then numbered, weighed, sterilized, 19 mm cubes of sapwood of the same species as the feeder strips were aseptically placed on top of the feeder strips, two blocks per jar, using 10" forceps. Blocks were soaked for at least 1 hour, and then autoclaved at 121°C and 15 psi for 20 minutes on the wet cycle.

Following incubation for a further 12 weeks, blocks were removed, surface mycelium gently scraped off, and wet weights determined. Notes on appearance and hardness of the wood were taken. Blocks were oven dried overnight, cooled, and final dry weights measured. Results are expressed as % weight loss relative to initial dry weight.

Control jars were treated in the same manner as experimental jars, but no liquid of any kind was introduced into vessels after autoclaving. Jars were incubated for each wood species during each test and weight losses

determined as above.

Vermiculite-sand matrix experiments

Strains marked with an asterisk above were also grown on a vermiculite-sand matrix containing a defined medium. Methodology for these tests was identical to that for the soil jar test with the following changes. Rather than soil, a mixture of 5 parts vermiculite and 6 parts medium washed river sand was added to each jar. Rather than water, 86 ml of a nutrient solution, identical to BM but with the carbon and nitrogen sources removed, pH adjusted to 4.5 with solid KOH, was added to each jar. This mixture had a moisture holding capacity of 39%. Cultures grown in BM were used as inocula.

CHEMICAL ANALYSES

Preparation of Wood for Analysis

Decayed blocks of wood were ground into sawdust using the method of Cowling (1961). The blocks were ground to pass through a 1 mm mesh wood was passed through 10 and 20 mesh screens twice, and 40 mesh once, on a small table top

mill. The 40 mesh and finer sawdust was collected after each step using a 40 mesh sieve.

Extraction of Wood

Sawdust was extracted using ethanol-benzene followed by 95% ethanol (TAPPI standard T12 OS-75). All ground wood from each treatment was placed in an oven dried, weighed 33 x 94 mm Whatman cellulose extraction thimble, oven dried overnight, cooled and weighed. The thimble and wood were placed in a 250 ml Soxhlet extractor, which was attached to a 250 ml round bottom flask containing 200 ml of ethanol-benzene, 1 volume ethanol to 2 volumes benzene, and several micro-porous boiling chips. A piece of 7 cm filter paper was folded into a funnel and placed over the top of the thimble to prevent spattering of the wood. The assembly was attached to a condenser, seated in a heating mantle, and held firmly to a scaffolding using clamps. The heating mantle was connected to a transformer, and with a current of 60-70 volts, the wood was extracted at a rate of four syphonings per hour.

After the extraction was completed, the assembly was allowed to cool overnight. The thimble was removed from the extractor using forceps, placed upright in a beaker, and the contents washed twice with 95% ethanol. The organic liquor was discarded and the glassware rinsed twice

with 95% ethanol. The thimble was placed back into the extractor, and extracted as above with 200 ml of 95% ethanol for 4 hours.

Following the ethanol extraction, the assembly was allowed to cool, and the thimble was removed. The thimble was left for a day in a fume hood to allow most of the ethanol to evaporate, then oven dried overnight. After cooling, the thimble and extracted wood were weighed, and the percentage of organic extractives calculated based on the original weight of the wood. Since only one sample of wood was extracted in each case, no error analysis was made. Control wood was extracted in triplicate.

Following organic extraction, the wood was extracted with hot water. Sawdust was transferred from the thimble into a 1000 ml erlenmeyer flask containing 500 ml of distilled water. The water-sawdust mixture was boiled for one hour on a hot plate, with a glass rod placed in the flask to prevent bumping. The sawdust was filtered from the water using a 500 ml coarse porosity scintered glass crucible of known weight. After oven drying, and cooling, the extracted wood was weighed. Water extractives are expressed as a percentage of the original, unextracted wood.

Klason lignin analysis of wood

Klason lignin percentage of the wood was determined using the method of Effland (1977). Three hundred mg samples of ground, extracted wood, weighed to 3 decimal places, were placed in 60 ml beakers. Three ml of 72% H_2SO_4 were added to each beaker, and the mixture stirred with a glass stirring rod until all the sawdust was wetted. The beakers and contents were incubated at room temperature for 1 hour, with periodic stirring. The contents of the beakers were transferred to 250 ml erlenmeyer flasks using 84 ml of distilled water. Flasks were capped with aluminum foil and autoclaved for 60 minutes at 121°C and 15 psi. After autoclaving, the contents of the flasks were filtered through 30 or 60 ml medium porosity sintered glass crucibles of known mass, using an aspirator, and washed with 100 ml of hot water. Samples were then oven dried, cooled, and weighed. Analysis of each sample was performed in triplicate. Klason lignin is expressed as a percentage of extracted wood. Acid soluble lignin was not measured due to lack of a suitable spectrophotometer.

Chlorite holocellulose determination of decayed wood

The method used to measure chlorite holocellulose was

developed by the U.B.C. Faculty of Forestry. Samples of approximately 500 mg of decayed, extracted wood, weighed to three decimal places, were placed in 50 ml Sovirel erlenmeyer flasks with threaded necks or 100 ml Sovirel sample bottles with threaded necks. To each flask, 7.0 ml of a buffer solution consisting of 60 ml acetic acid and 1.3 g NaOH per liter of water was added, followed by 3.0 ml of 20%, weight/weight, aqueous solution of sodium chlorite, NaClO_2 . The flasks were sealed using #22 or #25 caps with teflon liners, and incubated for 16 to 20 hours in a 50°C shaking incubator. The reaction was stopped by placing the flasks into cold water. The contents of the flasks were transferred to 60 ml coarse porosity scintered glass crucibles of known mass using 100 ml of 1% acetic acid, and an aspirator. The holocellulose was washed twice with 5 ml of acetone, gravity drained, then oven dried for two hours before weighing. Three replicates of each sample were run for the holocellulose determinations. The percentage of holocellulose in wood is expressed as a percentage of extracted wood. Holocellulose values were not corrected for residual lignin. A random selection of 12 holocellulose samples, using the microKappa number method of Berzins (1966) showed residual lignin in the holocellulose to be 1.71% with a standard error of 0.11%.

RESULTS

PRELIMINARY EXPERIMENTS

Results of the temperature growth experiment are shown in Figure 1. Dacrymyces stillatus KAS 2 grew best at 25°C, grew well at 20°C, but showed reduced growth at 15 and 30°C. Dacryopinax spathularia UBC 6101 grew best at 30°C but also grew very well at 25°C. On the basis of these results, 25°C was selected as the appropriate incubation temperature for soil block tests.

Figure 2 shows growth of D. stillatus KAS 2 in GM and BM. Growth was approximately four times greater in BM. The growth peak apparently occurred at 6 weeks, but no decline in dry weight was observed. Figure 3 shows the growth of D. spathularia UBC 6101 in GM and BM. Growth of this fungus in BM is also four times greater than in GM. The growth peak in BM is reached at 4 weeks; the growth peak was not reached in GM in 6 weeks. In BM dry weight declined after 4 weeks. Based on these experiments, BM was selected as the medium for growth of inocula for large soil block tests.

Figure 1: Growth of Dacrymyces stillatus KAS 2 and
Dacryopinax spathularia UBC 6101 on Nobles' MA.

△=15°C

□=20°C

△=25°C

○=30°C

Dacrymyces stillatus KAS 2

Dacryopinax spathularia UBC 6101

Figure 2: Growth of Dacrymyces stillatus KAS 2 in GM and BM.

Dacrymyces stillatus KAS 2

Figure 3: Growth of Dacryopinax spathularia UBC 6101 in GM and BM.

Dacryopinax spathularia UBC 6101

DECAY EXPERIMENTS

Soil Block Tests

Figures 4 to 31 show wood decayed by various species of Dacrymycetales. For purposes of comparison, control blocks are shown in Figures 32 to 38. Weight loss and chemical data for soil block experiments are contained in Tables II to IX. Chemical and moisture content data for controls are shown in Table I.

Four distinct types of decay were found on wood blocks decayed by members of the Dacrymycetales. The first type of rot was a uniform decay, resulting in a brownish discolouration of the wood. Considerable softening and shrinkage occurred at higher weight losses. The softening was usually concentrated in the earlywood, with late wood maintaining its integrity. Some cracking occurred upon drying. This type of rot was caused by all strains of Dacryopinax spathularia (Figs. 4-8, 21-25), Dacrymyces stillatus KAS 2 on alder, D. capitatus UBC 6143 (Fig. 9) on Douglas fir, D. dictyosporus UBC 6149 (Fig. 26) on ponderosa pine, Cerinomyces ceraceus UBC 6160 (Fig. 30) on alder, and to a lesser extent Dacrymyces palmatus UBC 6170. All of these strains degraded carbohydrates. With the exception of D. palmatus UBC 6170, all degraded significant amounts of lignin.

Figures 4-20: Wood blocks decayed by various species of Dacrymycetales. 4-8:Dacryopinax spathularia UBC 6101. 4:cedar sapwood. 5:Douglas fir. 6:alder. 7:hemlock. 8:maple. 9:Dacrymyces capitatus UBC 6143 on Douglas fir. 10:D. capitatus UBC 6144 on alder. 11:Calocera visoca UBC 6154 on Douglas fir. 12-17:Dacrymyces stillatus UBC 6147. 12:Douglas fir. 13:hemlock. 14:cedar sapwood. 15:cedar heartwood. 16:alder. 17:maple. 18:Calocera cornea UBC 6152 on alder. 19:C. cornea UBC 6177 on cedar sapwood.

Figures 21-31: Wood blocks decayed by various species of Dacrymycetales. 21-25:Dacryopinax spathularia UBC 6171. 21:Douglas fir. 22:hemlock. 23:cedar sapwood. 24:alder. 25:maple. 26:Dacrymyces dictyosporus UBC 6149 on ponderosa pine. 27:Dacrymyces novae-zelandiae UBC 6167 on alder. 28:Dacrymyces stillatus UBC 6145 on cedar sapwood. 29:Calocera lutea UBC 6150 on Douglas fir. 30:Cerinomyces ceraceus UBC 6160 on alder. 31:Calocera cornea UBC 6152 on ponderosa pine.

Figures 32-38: Control blocks. 32:Douglas fir. 33:hemlock. 34:cedar sapwood. 35:cedar heartwood. 36:alder. 37:maple. 38:ponderosa pine.

TABLE I: Chemical and moisture content data for controls.

SPECIES	%MC	%ORGANIC EXTRACTIVES		%WATER EXTRACTIVES		%KLASON LIGNIN		%HOLOCELLULOSE		%MIS- SING
		Std. error		Std. error		Std. error		Std. error		
Douglas fir	30-44	1.33	0.04	4.18	0.13	29.49	0.46	70.63	0.37	-0.12
hemlock	33-40	1.70	0.26	3.85	0.16	30.72	0.16	69.30	0.20	-0.02
cedar sap	27-91	1.63	0.25	4.01	0.07	32.13	0.27	66.04	0.38	1.83
cedar heart	28-36	2.12	0.35	4.58	0.24	33.21	0.30	64.38	0.81	2.41
pine	38	2.76	0.31	5.06	0.51	26.88	0.15	73.52	0.24	-0.50
maple	42-70	3.13	0.16	3.36	0.31	23.49	0.30	75.51	0.56	1.00
alder	34-97	2.21	0.33	2.50	0.20	24.42	0.91	74.72	0.19	0.86

TABLE II: Decay of wood by Dacrymyces palmatus. Weight loss data.

UBC#	ORIGINAL SUBSTRATE	SUBSTRATE	%MC	%WT.	LOSS
					Std. error
6170	unknown	Doug.fir	40.25	7.90	0.68
		hemlock	37.45	4.66	0.67
		cedar sap	40.38	4.51	0.45
		cedar heart	27.24	0.03	0.06
		alder	37.79	5.03	0.99
		maple	41.84	3.79	0.39
6120	fir	Doug.fir	48.86	0.43	0.07
6148	hemlock	Doug.fir	76.57	8.20	3.33
6166	conifer	Doug.fir	43.77	0.65	0.09
6176	unknown	Doug.fir	93.27	1.93	0.05
KAS 17	unknown	Doug.fir	130.31	1.64	0.11
A50-4	unknown	Doug.fir	87.15	1.35	0.07
A50-8	unknown	Doug.fir	132.94	1.28	0.10

TABLE III: Chemical analysis of wood decayed by Dacrymyces palmatus.

UBC#	WOOD	%WT.LOSS	%OE	%WE	%KLASON LIGNIN	Std. error	%HOLOCELLULOSE	Std. error	%CHANGE OE	%CHANGE WE	%CHANGE LIGNIN	%CHANGE HOLOCEL.	%MISSING
6170	DF	7.90	2.37	-----	31.34	0.21	62.95	0.22	-----	-----	-----	-----	-----
	H	4.66	3.05	4.60	32.44	0.19	61.24	0.20	71.05	13.91	-1.56	-17.62	6.32
	CS	4.51	2.09	4.66	32.56	0.21	65.57	0.25	22.44	10.97	-4.47	-6.30	1.87
	CH	0.03	2.20	3.12	33.74	0.50	70.57	0.24	3.74	-31.90	3.07	11.20	-4.31
	A	5.03	4.20	1.22	24.73	0.13	69.07	0.23	80.49	-53.65	-4.54	-12.87	6.20
	M	3.79	3.45	8.64	24.80	0.05	76.43	0.30	6.05	147.40	-4.51	-8.45	-1.23
6120	DF	0.43	2.56	2.82	29.41	0.54	72.83	1.26	91.65	-32.83	-0.56	2.81	-2.24
6148	DF	8.20	2.64	6.77	32.13	0.24	59.48	0.18	82.22	46.68	-4.11	-25.88	8.39
6166	DF	0.65	2.02	3.38	30.27	0.25	67.39	0.38	50.89	-19.66	2.10	-5.10	2.34
6176	DF	1.93	1.91	3.17	31.19	0.15	74.58	1.17	40.84	-25.63	4.20	4.03	-5.77
KAS17	DF	1.64	1.97	4.09	31.29	0.18	67.79	0.22	45.69	-3.76	3.76	-6.14	0.92

TABLE IV: Decay of wood by Dacrymyces stillatus. Weight loss data.

UBC#	ORIGINAL SUBSTRATE	SUBSTRATE	%MC	%WT.	LOSS Std. error
6146	conifer	Doug.fir	144.87	15.50	0.48
		hemlock	159.08	14.17	0.43
		cedar sap	268.46	20.25	1.27
		cedar heart	65.54	7.52	1.79
		alder	150.54	20.53	1.35
		maple	116.24	16.34	0.60
6147	conifer	Doug.fir	213.81	10.98	0.35
		hemlock	320.83	13.15	0.29
		cedar sap	172.52	9.79	0.44
		cedar heart	131.21	3.04	0.07
		alder	212.65	22.34	0.63
		maple	142.14	14.89	0.23
6145	conifer	cedar sap	338.23	13.69	1.04
KAS 2	maple	alder	44.55	9.40	1.03
A228-2	unknown	cedar sap	213.31	0.00	0.00
A228-7	unknown	cedar sap	204.83	0.00	0.00
a228-11	unknown	cedar sap	193.13	0.10	0.00

TABLE V: Chemical analysis of wood decayed by Dacrymyces stillatus.

UBC#	WOOD	%WT.LOSS	%OE	%WE	%KLASON LIGNIN	Std. error	%HOLOCELLULOSE Std. error	%CHANGE OE	%CHANGE WE	%CHANGE LIGNIN	%CHANGE HOLOCEL.	%MISSING	
6146	DF	15.50	-----	9.49	36.15	0.37	62.16	0.08	-----	-----	-----	1.69	
	H	14.17	3.42	6.46	34.39	0.07	63.36	0.26	72.67	44.02	-8.32	-25.12	2.25
	CS	20.25	3.04	5.96	33.56	0.20	64.75	0.34	48.74	18.53	-19.67	-24.59	1.69
	CH	7.52	4.40	4.76	34.53	0.29	68.22	0.21	91.94	-3.89	-6.34	-4.59	-2.75
	A	20.53	4.40	7.30	27.38	0.21	63.98	0.20	58.22	132.05	-17.43	-36.94	8.74
	M	16.34	3.39	5.82	25.59	0.05	65.21	0.25	-9.39	44.91	-11.51	-29.85	9.20
6147	DF	10.98	1.94	3.53	35.54	0.25	59.79	0.45	29.89	-24.82	7.33	-24.61	4.67
	H	13.15	2.56	5.39	36.21	0.64	60.55	0.49	30.79	21.59	-0.23	-26.04	3.24
	CS	9.79	1.81	4.75	34.22	0.26	63.62	0.10	0.17	6.86	-4.86	-13.94	2.16
	CH	3.04	2.87	2.48	35.07	0.20	61.97	0.61	31.26	-47.50	3.87	-5.32	2.96
	A	22.34	4.83	5.30	30.37	0.10	62.09	0.12	69.73	64.64	-8.91	-39.14	7.54
	M	14.89	2.77	5.33	25.41	0.10	68.45	0.18	-24.63	35.01	-9.52	-24.13	6.14
6145	CS	13.69	1.90	6.41	32.04	0.47	64.31	0.37	0.61	37.97	-16.38	-18.33	3.65
KAS2	A	9.40	2.79	5.69	26.90	0.70	60.23	0.49	14.38	106.21	-4.15	-29.86	12.87

TABLE VI: Decay of wood by Dacryopinax spathularia. Weight loss data.

UBC#	ORIGINAL SUBSTRATE	SUBSTRATE	%MC	%WT.	LOSS Std. error
6101	unknown	Doug.fir	157.47	33.53	0.56
		hemlock	138.89	29.64	1.07
		cedar sap	132.34	33.77	0.73
		cedar heart	26.81	0.09	0.04
		pine*	174.39	41.96	0.64
		alder	81.90	23.85	2.02
		maple	153.70	29.82	1.63
6126	apple	Doug.fir	175.85	12.52	1.20
		hemlock	163.40	15.34	0.84
		cedar sap	-----	23.52	2.48
		maple	145.48	22.61	1.38
6171	unknown	Doug.fir	133.37	26.17	0.78
		hemlock	140.92	29.14	0.62
		cedar sap	120.84	32.55	0.86
		cedar heart	34.33	0.37	0.27
		alder	111.47	18.28	1.37
		maple	150.22	29.93	0.43
6171-2	unknown	Doug.fir	180.61	8.01	1.42
6171-4	unknown	Doug.fir	122.53	7.30	2.47
6171-7	unknown	Doug.fir	115.85	2.31	0.35

*-Incubation time 15 weeks.

TABLE VII: Chemical analysis of wood decayed by Dacryopinax spathularia.

UBC#	WOOD	%WT.LOSS	%OE	%WE	%KLASON LIGNIN	Std. error	%HOLOCELLULOSE	Std. error	%CHANGE OE	%CHANGE WE	%CHANGE LIGNIN	%CHANGE HOLOCEL.	%MISSING
6101	DF	33.53	9.26	5.37	48.17	0.37	47.86	0.60	362.79	-14.61	-1.90	-59.31	3.97
	H	29.64	9.57	6.54	42.72	0.08	48.08	0.14	296.09	19.52	-13.10	-56.64	9.20
	CS	33.77	11.33	7.60	46.11	0.16	46.99	0.15	360.36	25.52	-18.34	-59.51	6.90
	CH	0.09	4.24	5.51	33.11	0.20	66.20	0.21	99.82	20.20	-3.64	-0.62	0.69
	PP	41.96	10.67	13.34	52.69	0.37	36.85	0.04	124.38	53.01	-6.21	-76.02	10.46
	A	23.85	9.19	7.50	28.57	1.72	59.61	0.21	216.66	128.45	-22.11	-46.89	11.82
	M	29.82	8.39	5.30	30.31	0.76	59.12	0.24	88.12	10.70	-16.42	-49.28	10.57
6126	DF	12.52	3.37	7.01	31.72	0.08	61.89	0.02	121.66	46.71	-10.75	-27.30	6.38
	H	15.34	2.81	4.82	34.27	0.40	58.57	0.25	39.94	5.99	-7.64	-30.02	7.16
	CS	23.52	4.39	8.25	-----	---	59.51	0.11	105.98	57.35	-----	-36.19	-----
	M	22.61	5.28	7.05	26.60	0.07	63.97	0.24	30.55	62.38	-17.84	-38.53	9.43
6171	DF	26.17	5.05	7.97	39.97	0.61	56.58	0.23	180.33	40.77	-7.89	-45.56	3.45
	H	29.14	5.61	8.26	50.33	0.76	49.69	0.23	133.84	52.03	5.87	-53.67	-0.02
	CS	32.55	5.88	12.02	42.95	0.23	53.03	0.50	143.32	102.18	-21.55	-52.87	4.02
	CH	0.37	4.19	3.53	42.70	0.08	62.07	0.56	96.91	-23.21	26.70	-4.99	-4.77
	A	18.28	4.44	6.04	27.41	0.47	61.76	0.09	64.18	97.44	-13.83	-36.54	10.83
	M	29.93	8.09	7.17	29.98	0.42	56.53	0.23	81.11	49.52	-18.96	-52.46	13.49

TABLE VIII: Decay of wood by various species in the Dacrymycetales. Weight loss data.

FUNGUS	UBC#	ORIGINAL SUBSTRATE	SUBSTRATE	%MC	%WT.	LOSS Std. error
<u>Calocera</u>						
<u>cornea</u>	6151	hardwood	alder	104.16	4.04	0.45
	6152	hardwood	alder	83.64	2.80	0.39
	6152	hardwood	pine	115.75	11.89	0.72
	6153	hardwood	alder	107.29	1.38	0.20
	6169	bamboo	alder	114.36	16.53	1.52
<u>lutea</u>	6150	unknown	Doug.fir	120.15	18.97	1.12
<u>viscosa</u>	6154	conifer	Doug.fir	91.28	3.91	0.39
	6168	conifer	Doug.fir	62.97	2.85	0.15
<u>Cerinomyces</u>						
<u>canadensis</u>	6094	Doug.fir	Doug.fir	43.85	0.96	0.07
<u>ceraceus</u>	6160	magnolia	alder	136.17	19.88	0.52
<u>crustulinus</u>	6108	unknown	pine	33.96	0.25	0.03
<u>Dacrymyces</u>						
<u>capitatus</u>	6125	alder	alder	31.76	0.77	0.01
	6143	hardwood	Doug.fir	125.89	15.44	0.47
	6144	oak	alder	207.20	36.47	2.02
<u>dictyosporus</u>	6121	pine	pine	67.84	0.33	0.06
	6149	unknown	pine	214.81	26.56	2.57
<u>minor</u>	6177	unknown	cedar sap	207.48	4.10	0.52
<u>minutus</u>	6175	conifer	Doug.fir	70.18	1.42	0.10
<u>novae-zelandiae</u>	6167	unknown	alder	124.93	5.66	0.70
<u>punctiformis</u>	6167	pine	pine	32.38	0.33	0.04
<u>Heterotextus</u>						
<u>luteus</u>	6165	Doug.fir	Doug.fir	35.79	0.38	0.08

TABLE IX: Chemical analysis of wood decayed by various species of Dacrymycetales.

UBC#	WOOD	%WT.LOSS	%OE	%WE	%KLASON LIGNIN	Std. error	%HOLOCELLULOSE	Std. error	%CHANGE OE	%CHANGE WE	%CHANGE LIGNIN	%CHANGE HOLOCEL.	%MISSING
<u>Calocera cornea</u>													
6151	A	4.04	1.21	3.55	25.56	0.34	73.43	0.36	-47.46	36.26	0.39	-5.75	1.01
6152	A	2.80	1.30	2.89	25.18	0.08	75.05	0.23	-42.82	12.36	0.77	-1.84	-0.23
	PP	11.89	4.09	6.38	30.21	2.49	62.20	0.54	30.57	11.10	-3.82	-27.60	7.59
6153	A	1.38	1.65	2.75	21.41	0.45	78.69	0.39	-26.37	8.43	-13.25	4.20	-0.10
6169	A	16.53	3.05	4.14	26.53	0.11	72.34	0.33	15.20	38.23	-11.68	-21.29	1.13
<u>C. lutea</u>													
6150	DF	18.97	4.29	5.75	34.56	0.42	60.06	0.15	161.37	11.46	-9.59	-34.40	5.38
<u>C. viscosa</u>													
6154	DF	3.91	2.24	4.81	28.93	0.10	70.58	0.53	61.84	10.57	-7.27	-5.54	0.49
6168	DF	2.85	1.32	5.24	31.53	0.14	67.32	0.28	-3.58	21.79	2.72	-8.43	1.15
<u>Cerinomyces canadensis</u>													
6094	DF	0.96	1.34	2.92	30.45	0.03	64.82	0.62	-0.22	-30.81	3.61	-7.90	4.73
<u>C. ceraceus</u>													
6160	A	19.88	5.32	7.21	25.13	0.21	66.07	0.23	92.87	131.07	-24.32	-34.97	8.80
<u>C. crustulinus</u>													
6108	PP	0.25	4.21	6.74	28.76	0.14	63.21	0.34	52.15	32.87	3.10	-17.15	8.03

continued...

TABLE IX (continued):

UBC#	WOOD	%WT.LOSS	%OE	%WE	%KLASON LIGNIN	Std. error	%HOLOCELLULOSE	Std. error	%CHANGE OE	%CHANGE WE	%CHANGE LIGNIN	%CHANGE HOLOCEL.	%MISSING
<u>Dacrymyces capitatus</u>													
6125	A	0.77	1.42	1.94	23.77	0.16	71.60	0.10	-36.24	-23.00	-2.04	-3.57	4.63
6143	DF	15.44	2.45	7.10	31.80	0.16	61.94	0.30	55.77	43.63	-12.01	-29.01	6.26
6144	A	36.47	5.83	8.40	29.50	0.12	63.13	0.23	67.59	113.46	-30.92	-51.69	7.37
<u>D. dictyosporus</u>													
6121	PP	0.33	3.79	3.09	28.77	0.74	70.76	0.31	36.87	-39.13	7.77	-3.09	0.47
6149	PP	26.56	5.75	8.50	33.73	0.16	63.93	0.06	53.00	23.37	-14.22	-40.59	2.32
<u>D. minor</u>													
6177	CS	4.10	—	5.21	32.76	0.14	67.77	0.26	—	—	—	—	0.58
<u>D. minutus</u>													
6175	DF	1.42	1.90	3.05	33.05	0.45	68.23	0.29	40.83	-28.07	11.14	-4.21	-1.28
<u>D. novae-zelandiae</u>													
6167	A	5.66	2.22	2.83	24.88	0.03	76.82	0.49	-5.23	6.79	-4.23	-3.35	-1.70
<u>D. punctiformis</u>													
6124	PP	0.33	3.39	3.50	28.76	0.31	67.40	0.03	22.42	-31.06	7.71	-7.70	3.83
<u>Heterotextus luteus</u>													
6165	DF	0.38	2.06	4.16	31.62	0.72	69.17	0.27	54.30	-0.86	6.01	-3.17	-0.79

The second type of decay produced was a brown pocket rot, in which small, linear to irregularly ellipsoid pockets of wood, up to 5 mm in diameter, were discoloured brown. Signs of softening and collapse of the tissue within the pockets were sometimes evident. Pockets were usually more numerous at the bottom of the blocks. This type of decay was caused by Calocera cornea UBC 6151, UBC 6152 (Fig. 18), UBC 6153, UBC 6169 (Fig. 19), Dacrymyces capitatus UBC 6144 (Fig. 10), and D. novae-zelandiae UBC 6167 (Fig. 27) all on alder, and D. palmatus UBC 6148 on Douglas fir. All of these strains degraded carbohydrates, but only C. cornea UBC 6169, D. capitatus UBC 6144 and D. novae-zelandiae UBC 6167 degraded lignin to any extent.

The third type of rot decayed and discoloured the wood brown progressively from the bottom of the block upwards. Earlywood disappeared at the base of the blocks, leaving a brown skeleton of latewood. Dried blocks were brittle and slightly shrunken at the base. This type of decay was caused by Dacrymyces stillatus UBC 6147 (Fig. 12-17) and UBC 6146 on all types of wood, UBC 6145 (Fig. 28) on cedar sapwood, Calocera cornea UBC 6152 (Fig. 31) on ponderosa pine, and Dacrymyces minor UBC 6177 (Fig. 20) on cedar sapwood. Extensive degradation of carbohydrates occurred with these strains. Variable amounts of lignin were also removed.

The fourth type of decay is similar to a white-rot.

There was little or no discolouration of the wood, but some softening and shrinkage occurred. Softening was concentrated in the earlywood. This type of decay was caused by Calocera lutea UBC 6150 (Fig. 29), and C. viscosa UBC 6154 (Fig. 11) and UBC 6168, all on Douglas fir. Carbohydrates were reduced by all three strains. C. lutea UBC 6150 and C. viscosa UBC 6154 removed significant amounts of lignin.

Several strains tested showed little or no capacity to decay wood, and caused no changes in the appearances of the blocks. These strains were Dacrymyces palmatus UBC 6120, UBC 6166, UBC 6176, KAS 17 on Douglas fir, D. capitatus UBC 6125 on alder, D. minutus UBC 6175 on Douglas fir, D. punctiformis UBC 6124 on ponderosa pine, Cerinomyces canadensis UBC 6094 on Douglas fir, C. crustulinus UBC 6108 on ponderosa pine, and Heterotextus luteus UBC 6165 on Douglas fir. Chemical data for these strains, because of low weight losses, are difficult to interpret, but most of these strains appear to have been reducing the extractive portion of the wood. D. palmatus UBC 6166 and KAS 17, D. capitatus UBC 6125, Cerinomyces canadensis UBC 6094 and C. crustulinus UBC 6108 depleted the carbohydrates to some extent.

All of the monokaryons tested showed a reduced capacity to decay wood. Monokaryons of D. palmatus KW-A-50, grown on Douglas fir, and of D. stillatus, KW-A-228 grown on

cedar sapwood, did not decay wood. Monokaryons derived from Dacryopinax spathularia UBC 6171 showed extreme variation in ability to grow on and decay Douglas fir. Some blocks supported extensive growth and displayed considerable softening of the earlywood. Others supported little growth and displayed little or no softening. Decayed blocks were of the uniform brown-rot type. No chemical analysis of wood decayed by monokaryons was carried out.

Comparison Tests

Weight loss and moisture content data for the four species of Aphyllophorales tested are summarized in Table X. No chemical analysis of this wood was performed.

Poria placenta 120F grew very well on ponderosa pine. The blocks were discoloured to a dark brown colour, and considerable softening was noted. Earlywood was softer than latewood. Upon drying, the wood showed extensive shrinkage and cracking; many of the blocks were difficult to handle without disintegrating.

Poria subvermispora L6332 showed excellent growth on ponderosa pine. Blocks were bleached white but not noticeably softened. No shrinkage was noted upon drying.

Phanerochaete chrysosporium ME461 and Coriolus versicolor 105E both grew excellently on alder. Blocks were bleached white, extremely soft, and clearly of reduced

TABLE X: Decay of wood by some fungi in the Aphyllophorales.
Weight loss data.

Fungus	WFPL#	%MC	% WT.	LOSS Std. error
<u>C. versicolor</u>	105E	199.31	52.54	7.06
<u>P. chrysosporium</u>	ME461	167.12	49.51	2.97
<u>P. placenta</u>	120F	234.60	61.09	2.50
<u>P. subvermispora</u>	L6332	43.77	21.05	1.20

density. No shrinkage was noted upon drying, but the wood was of a spongy consistency.

Vermiculite-Sand Matrix

Weight loss and moisture data for fungi grown on the vermiculite-sand matrix are shown in Table XI. No chemical analysis of this wood was performed.

No significant changes in wood appearance were caused by Cerinomyces canadensis UBC 6094 on Douglas fir, Dacrymyces capitatus UBC 6125 on alder, D. palmatus UBC 6120 and UBC 6166 on Douglas fir, D. dictyosporus UBC 6121 and D. punctiformis UBC 6124 on ponderosa pine, and Heterotextus luteus UBC 6165 on Douglas fir. Brown pocket rots, as described above, were caused by D. palmatus UBC 6148 on Douglas fir, and D. spathularia UBC 6101 on alder and hemlock, and UBC 6126 on Douglas fir and hemlock. Calocera cornea UBC 6152 on ponderosa pine and Cerinomyces ceraceus UBC 6150 on alder caused the same types of decay as on the soil matrix, but to a much lesser extent.

TABLE XI: Decay of wood by various species of Dacrymycetales on a vermiculite-sand matrix. Weight loss data.

FUNGUS	UBC#	ORIGINAL SUBSTRATE	SUBSTRATE	%MC	%WT .	LOSS Std. error
<u>Calocera</u> <u>cornea</u>	6152	hardwood	pine	-----	0.08	0.05
<u>Cerinomyces</u> <u>canadensis</u>	6094	Doug fir	Doug fir	156.00	0.04	0.03
<u>ceraceus</u>	6160	Magnolia	alder	82.77	4.48	0.89
<u>Dacrymyces</u> <u>capitatus</u>	6125	alder	alder	69.12	0.06	0.02
<u>dictyosporus</u>	6121	pine	pine	117.58	0.00	0.00
<u>palmatus</u>	6166	conifer	Doug fir	91.48	0.10	0.03
	6148	hemlock	Doug fir	139.21	2.06	1.09
	6120	fir	Doug fir	133.48	0.06	0.03
<u>punctiformis</u>	6124	pine	pine	116.84	0.00	0.00
<u>Dacryopinax</u> <u>spathularia</u>	6101	unknown	Doug fir	-----	0.15	0.11
			hemlock	-----	0.72	0.05
			cedar sap	-----	0.02	0.02
			cedar heart	-----	0.00	0.00
			alder	-----	0.77	0.13
			maple	-----	1.40	0.24
	6126	apple	Doug fir	199.77	0.55	0.12
			hemlock	175.94	0.61	0.25
			cedar sap	-----	0.00	0.00
			maple	-----	6.52	2.56
<u>Heterotextus</u> <u>luteus</u>	6165	Doug fir	Doug fir	-----	0.00	0.00

DISCUSSION

This study confirms the preliminary results of Shields and Shih (1975) and demonstrates that species in the Dacrymycetales cause a significant primary decay of wood. In particular, Dacrymyces stillatus, D. capitatus, D. dictyosporus, Dacryopinax spathularia, Cerinomyces ceraceus, Calocera cornea and C. lutea may cause extensive decay. Noteworthy decay may also be caused by Dacrymyces palmatus, D. minor, D. novae-zelandiae, and Calocera viscosa. Of sixteen species studied, only Cerinomyces canadensis, C. crustulinus, Dacrymyces minutus, D. punctiformis, and Heterotextus luteus, showed little capacity to decay wood. Chemical data for these strains suggest they subsist on extractive components of wood. The failure of these strains to decay wood should not be considered absolute statements for the species involved. As discussed below, the age of the culture and the substratum it is grown on may have considerable effect on the decay produced. The Dacrymycetales studied here decay wood at levels comparable to many of the polypores and agarics classically considered strong decay fungi (Humphrey 1923; Bailey 1941; Cowling 1961; DaCosta and Kerruish 1965;

Amburgey 1967; Abou-Heilah et al. 1977; Elliot et al. 1979; Setliff and Eudy 1981; Highley 1982).

The decay caused by most members of the Dacrymycetales tested is morphologically identical to brown-rotted wood produced by members of the homobasidiomycetes (Gilbertson 1981). The wood is discoloured brown, shrunken, and brittle. As is typical for brown-rotted wood, the moisture content is high and extensive removal of carbohydrates has occurred. Many of the species tested, however, including Dacryopinax spathularia, Dacrymyces stillatus, D. capitatus, D. dictyosporus, Calocera cornea, C. lutea, and Cerinomyces ceraceus, are capable of removing significant amounts of lignin. Crawford (1981) has reviewed the effects of brown-rotting homobasidiomycetes on lignin. Brown-rot fungi initially degrade lignin in a similar manner to white-rot fungi. Demethylation, hydroxylation and side chain oxidations occur, but unlike white-rots, brown-rot fungi appear unable to cleave the aromatic nuclei of lignin. However, there is some evidence that strains of some brown-rot fungi may be able to cleave lignin's aromatic ring. Haider and Trojanowski (1980) found that Gloeophyllum trabeum (Fr.) Murr., G. abietinum (Fr.) Karst., G. saepiarium (Fr.) Karst. and Poria contigua (Pers.) Karst. released significant amounts of $^{14}\text{-CO}_2$ from DHP and corn stalk lignin which had labelled aromatic rings. The high lignin losses caused by some

members of the Dacrymycetales suggests extensive ring cleavage may be occurring. Indeed, the ratios of lignin to carbohydrates removed, which are approximately 0.25-1.0 for the species of Dacrymycetales suspected of degrading lignin, are comparable to those of many white-rot fungi (Setliff and Eudy 1980).

The production of a brown pocket rot by some members of the Dacrymycetales is worthy of note. Brown pocket rots are caused by some members of the Polyporaceae, but are not common. Boyce (1961) described brown pocket rots caused by a number of fungi in this family. Typically these rots are long narrow columns of cubical brown-rot, separated by apparently sound wood, occurring in the heartwood. The brown pocket rots produced by species of the Dacrymycetales are difficult to compare to this because of the small size of the pockets. The occurrence of the pocket rot appears to have some relationship with substratum. Calocera cornea UBC 6152, for example, produced a pocket rot on alder but a basal brown-rot on ponderosa pine.

Gilbertson (1980, 1981) has remarked upon the correlation between white-rot fungi and angiosperms, and brown-rot fungi and gymnosperms. Several workers have investigated the factors which may influence the preferences for different types of wood among wood decay fungi (Highley 1973, 1976, 1982; Rypacek 1976). The substratum index in Appendix 2 shows that many species in

the Dacrymycetales do show preference for angiosperm or gymnosperm wood. Although there are differences in rates of decay on different substrata, the broad specificity expressed in nature is not always apparent for Dacrymycetaceous fungi in the soil block test. Dacryopinax spathularia is most often reported from angiosperms yet UBC 6101 and 6171 caused more weight loss on gymnosperm wood than on angiosperm wood. Calocera cornea is most often reported from angiosperms. C. Cornea UBC 6152, isolated from an angiosperm, decayed ponderosa pine far better than it did alder.

There are several explanations for the differing abilities of individual isolates of the same species to decay wood. This type of variation is not unusual for wood decay fungi (DaCosta and Kerruish 1965; Amburgey 1967; Abou-Heilah et al. 1977; Elliot et al. 1979; Setliff and Eudy 1980; Reid and Seifert 1982). Genetic variability is the most likely cause. Genetic variation is reflected in differences among isolates from separate geographical localities. An example of this is the four strains of Calocera cornea grown on alder. All cultures were approximately of the same age, but the isolate from Papua-New Guinea decayed alder much better than did the eastern North American strains. Abou-Heilah & Hutchinson (1978) correlated wood decaying abilities of different isolates of Serpula lacrymans (Fr.) Scroet. with levels of

extracellular cellulases produced. This may be one type of genetic variation affecting decay by the Dacrymycetales in this study.

Cultures of wood decay fungi have been suspected of losing their wood decaying abilities with age. My data indicate that this phenomenon occurs with some species in the Dacrymycetales. The two old isolates of Dacrymyces palmatus, UBC 6166 and 6120, 47- and 16-years old respectively, did not decay wood, while the other isolates, all less than a year old, did cause some decay. Similarly, an 8 year old culture of Dacrymyces capitatus, UBC 6125, and a 14 year old culture of D. dictyosporus, UBC 6121, failed to decay wood, while fresh cultures of both species decayed wood very well. These differences, which may be attributable to genetic variation, suggest that cultures of Dacrymycetaceous fungi may change over time. I have also observed, particularly with D. palmatus, a gradual or sudden loss of the ability to synthesize carotenoid pigments after many transfers. Care must be taken in drawing conclusions from experiments performed with old cultures.

The ability of Dacrymyces stillatus to decay cedar heartwood is worthy of mention. Heartwood of western red cedar is highly resistant to decay by most fungi because of high levels of thujaplicin (Johnson & Cserjesi 1980). Whereas Dacryopinax spathularia and Dacrymyces palmatus

caused no significant decay of cedar heartwood, both isolates of D. stillatus caused a significant, if reduced, amount of decay. This indicates a certain amount of tolerance to thujaplicin. Other fungi which have been noted as resistant to thujaplicin are the hyphomycetes, Phialophora hoffmannii (Beyma) Schol-Schwarz and Exophiala mansonii (Castell.) deHoog (Smith and Swann 1968), and the homobasidiomycete Poria incrassata (Berk. & Curt.) Burt (Humphrey 1923).

Wood preservatives, particularly those containing arsenic, may induce spontaneous monokaryon formation in dikaryotic mycelium of some fungi (DaCosta and Kerruish 1962; Kerruish and DaCosta 1963; Amburgey 1967). It is important, then, to determine the comparative decay capabilities of monokaryons and dikaryons of fungi found on wood products in service. The results for Dacryopinax spathularia show that monokaryons of this species have a reduced capacity to decay wood. Similar results have been reported for monokaryons of Fomes igniarius (Fr.) Gill. (Verrall 1937), and Pleurotus corticatus Fr. (Kaufert 1936). Fungi in which monokaryons are more or equally effective in decay of wood include Ganoderma applanata (Gray) Pat. (Aoshima 1954), Poria vaillantii (DC:Fr.) Cooke (DaCosta and Kerruish 1965), Gloeophyllum trabeum (DaCosta and Kerruish 1965; Amburgey 1967) and Serpula lacrymans (Elliot et al. 1979). The high standard error

for D. spathularia, and the various levels of decay that were evident upon visual examination of blocks decayed by any one strain, suggests that monokaryons may have some difficulty in colonizing wood.

The data for Dacrymyces palmatus monokaryons are not conclusive, since the monokaryons cannot be compared directly to any of the dikaryons tested. Since D. palmatus is often a weak decay fungus, the low weight losses caused by the monokaryons do not necessarily imply a reduced capacity for decay.

Monokaryons of D. stillatus did not decay wood. If this is a correct result, it is indeed a surprise. No previous work known to me documents a strong decay fungus whose monokaryons are completely unable to decay wood. It is worth mentioning, in this regard, that the collection these cultures were isolated from originated in West Germany. Perhaps the European strains of this taxon are not as effective in wood decay as the North American counterparts.

The failure of the defined vermiculite-sand matrix to support significant decay is disappointing. Two problems must be solved before this method can be used for testing of wood decay fungi. First, the extremely high moisture contents of blocks placed on this matrix suggests that the wood may have been saturated with water, effectively preventing any decay from occurring. Evidently, the

moisture holding and moisture releasing characteristics of vermiculite and sand differ considerably from those of soil. Addition of some clay to the matrix to hold water may be advisable. The moisture relations of any new defined matrix with wood moisture and decay properties must be optimized by trial and error. Adherence to the ASTM standard recommendations for moisture and moisture holding capacity is not advisable in this case. Secondly, the types and levels of nutrients included in the broth are inadequate when compared with those found in the soil analysis. Given the low concentration of nitrogen in wood, and the relatively high content in soil, certainly a nitrogen source should be included in the broth. Higher levels of phosphorus would also be desirable.

Given that the Dacrymycetales can be considered effective wood decay fungi, it seems likely that other families within the heterobasidiomycetes may contain equally potent wood decayers. Table XII lists types of decay associated with specimens of various heterobasidiomycetes, based on literature reports and on specimens in the UBC herbarium. Table XIII lists types of decay associated with members of the Dacrymycetales not tested in this study.

TABLE XII: Type of rot associated with wood inhabiting members of the heterobasidiomycetes believed to be saprophytic (excluding Dacrymycetales). Based on herbarium specimens in UBC.

FUNGUS	HOST	TYPE OF ROT
TREMELLALES		
<u>Aporpium caryae</u> (Schw.)Teixeira & Rogers	<u>Ulmus</u>	white
<u>Ductifera pululahuana</u> (Pat.)Donk	angiosperms	white
<u>Ductifera sucina</u> (Moller)Wells	angiosperms	white
<u>Eichleriella spinulosa</u> (Berk. & Curt.)Burt	<u>Populus</u>	white
<u>Eichleriella macrospora</u> (E. & E.) Martin	Elder	white
<u>Exidia candida</u> Lloyd	<u>Alnus, Betula</u>	white
<u>Exidia glandulosa</u> Fr.	angiosperms	white
<u>Exidia iteinos</u> Klett	<u>Salix</u>	white
<u>Exidia populi</u> J. Erikson	<u>Populus</u>	white
<u>Exidia recisa</u> Fr.	angiosperms	white
<u>Exidia repanda</u> Fr.	<u>Alnus, Betula</u>	white
<u>Exidia saccharina</u> Fr.	<u>Picea, Pinus</u>	white
<u>Exidia zelleri</u> Lloyd	angiosperms	white
<u>Exidiopsis calcea</u> (Pers.)Wells	<u>Alnus</u>	white
<u>Exidiopsis glaira</u> (Lloyd)Wells	unknown	brown?
<u>Exidiopsis grisea</u> (Pers.)Bourd. & Maire	<u>Alnus, Salix</u>	white
<u>Exidiopsis laccata</u> (Bourd. & Maire)Wells	unknown	white
<u>Exidiopsis molybdea</u> (McGuire)Erwin	unknown	white
<u>Exidiopsis plumbescens</u> (Burt)Wells	angiosperms	white
<u>Exidiopsis sublilacina</u> (Martin)Erwin	<u>Alnus</u>	white
<u>Heterochaete albida</u> Pat.	unknown	white
<u>Heterochaete sublivida</u> Pat.	unknown	white
<u>Holtermannia corniformis</u> Kobayasi	unknown	white
<u>Myxarium podlachia</u> (Bres.)Raitvir	<u>Alnus</u>	white
<u>Phlogiotis helvelloides</u> (Fr.)Martin	conifers	brown
<u>Protodaedalea hispida</u> Imazeki	unknown	white
<u>Pseudohydnum gelatinosum</u> (Fr.)Karst.	conifer	brown or white
AURICULARIALES		
<u>Auricularia auricula</u> (Hook)Underw.	angiosperms	white
<u>Auricularia fuscusuccinea</u> (Mont.)Farl.	angiosperms	white
<u>Helicogloea lagerheimi</u> Pat.	angiosperms	white

TABLE XIII: Type of rot associated with various species of the Dacrymycetales based on herbarium specimens in UBC.

FUNGUS	TYPE OF ROT
<u>Calocera sinensis</u> McNabb	white
<u>Cerinomyces lagerheimi</u> (Pat.)McNabb	brown
<u>Dacrymyces abietinus</u> Schroet.	brown
<u>D. enatus</u> (Berk. & Curt.)Mass.	brown?
<u>D. ovisporus</u> Bref.	brown
<u>D. sebaceus</u> Berk. & Br.	white
<u>Dacryonaema rufum</u> (Fr. per Fr.)Nannf.	brown
<u>Dacryopinax elegans</u> (Berk. & Curt.)Martin	white
<u>Ditiola radicata</u> (Berk. & Curt.)L. Kennedy	brown or white
<u>Heterotextus alpinus</u> (Tracy & Earle)Martin	brown

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APPENDIX 1: MEDIA EMPLOYED

Composition of Glucose Malt medium (GM)

Components	g/l
D-glucose	10.0
Difco malt extract	12.5
distilled H ₂ O	1000

Composition of Balanced Medium (BM) for Phanerochaete chrysosporium (Reid & Seifert 1982)

Components	g/l
D-glucose	10.0
NH ₄ Cl	0.5
KH ₂ PO ₄	0.18
K ₂ SO ₄	0.05
MgCl ₂ ·6H ₂ O	0.5
thiamine	0.0001
trace element solution	0.1 ml
distilled H ₂ O	1000

Composition of Nobles' malt agar (MA) (Nobles 1965)

component	g/l
malt extract	12.5
Difco Bacto-agar	15.0
distilled H ₂ O	1000

Composition of MYP and MYPT media (Bandoni 1972).

components	g/l
Malt extract	7.0
Soytone	1.0
Yeast extract	0.5
Distilled H ₂ O	1000
ICN agar	6

For MYPT, 100 mg of tetracycline per litre, dissolved in a few mls of 95% ethanol, are added after autoclaving.

APPENDIX 2: SUBSTRATUM INDEX

This index provides lists of recorded substrates for species in the Dacrymycetales. Each list is divided into two parts; first, angiosperm substrata, then coniferous substrata. Numbers following substrata refer to literature listed at the end of this appendix only. Citations to UBC refer to specimens in the UBC herbarium, or to cultures in the UBC culture collection.

CALOCERA CORNEA (Batsch:Fr.) Fr.

- Acer macrophyllum (12)
- Acer sp. (20)
- Alnus rubra (12, UBC)
- Alnus sp. (UBC)
- Corylus avellana (17)
- Fagus sylvatica (17)
- Fraxinus sp. (19)
- Populus tremuloides (11, 12, 17, UBC)
- Populus trichocarpa (12)
- Prunus avicum? (17)
- Prunus carasus (17)
- Prunus emarginata (12)
- Prunus sp. (UBC)
- Quercus suber (17)
- Quercus sp. (2, 17, 19, 20)
- Salices anonymae (17)
- Salix sp. (UBC)
- Sorbus aucuparia (17, 19)
- Tilea sp. (19)
- Ulmus campestris (17)
- Ulmus sp. (19)

- Abies sp. (20)
- Pinus sylvestris (17)
- Pinus sp. (20)

- Bambusa sp. (UBC)

CALOCERA FURCATA (Fr.) Fr.

- Abies sachalinensis (10)
- Abies sp. (19)
- Pinus excelsa (17)
- Pinus sylvestris (17)
- Pinus sp. (19)

CALOCERA GLOSSOIDES (Pers.:Fr.) Fr.

Acer pseudoplatanus (19)
Alnus glutinosus (19)
Fagus sp. (19)
Quercus sp. (17, 19, 20)

CALOCERA PALLIDO-SPATHULATA Reid

Larix sp. (19)
Picea sp. (19)

CALOCERA VISCOSA (Pers.:Fr.) Fr.

Acer macrophyllum (UBC)
Quercus sp. (17)

Abies alba (17)
Picea excelsa (17)
Picea sitchensis (UBC)
Pinus sylvestris (17)
Pinus sp. (20, UBC)
Pseudotsuga menziesii (21)
Thuja plicata (12, UBC)

Magnolia fraseri (20)
Magnolia virginiana (20)

CERINOMYCES CANADENSIS (Jacks. & Martin) Martin

Pseudotsuga menziesii (UBC)

CERINOMYCES CERACEUS Ginns

Magnolia grandiflora (8)

CERINOMYCES CRUSTULINUS (Bourd. & Galz.) Martin

Quercus sp. (2)
Pinus sp. (5)

CERINOMYCES PALLIDUS Martin

Malus sp. (13)
Quercus sp. (13)

DACRYMYCES ABIETINUS Schroet.

Picea engelmannii (15)
Pinus ponderosa (4)
Pinus strobus (2)

Pinus sp. (3, 12)
Thuja plicata (12, UBC)
Thuja sp. (2)

DACRYMYCES ADPRESSUS Grogg.

Larix kaempferi (9)
Picea excelsa (17)

DACRYMYCES CAESIUS Sommerf.

Salices anonymae (17)
Salix alba (17)

DACRYMYCES CAPITATUS Schw.

Acer sp. (20, UBC)
Alnus glutinosus (19)
Alnus rubra (12, UBC)
Alnus rugosa (UBC)
Alnus sinuata (UBC)
Alnus sp. (3, 20)
Betula lutea (3)
Betula sp. (20)
Cedrus atlantica (19)
Cytisus sp. (12, UBC)
Populus tremuloides (UBC)
Populus trichocarpa (12, UBC)
Prunus padus (19)
Quercus sp. (1, 19, 20, UBC)
Rubus spectabilis (12)
Rubus sp. (UBC)
Salix sp. (3, 12, UBC)
Sambucus racemosa (12)
Sambucus sp. (UBC)
Viburnum sp. (19)

Abies sp. (UBC)
Picea sp. (15)
Pinus sp. (UBC)

DACRYMYCES CHRYSOCOMUS (Bull.:Fr.) Tul.

Abies sp. (20)
Picea excelsa (17)
Pinus densiflora (9)
Pinus sylvestris (17, 19)
Pinus sp. (5, 20)

DACRYMYCES CONFLUENS Karst.

Pinus sylvestris (17)

DACRYMYCES CORTICIOIDES Ell. & Ev.

Pinus rigidus (20)
Pinus strobus (20)
Pinus sylvestris (17)
Tsuga canadensis (20)

DACRYMYCES DICTYOSPORUS Martin

Pinus engelmannii (UBC)
Pinus oocarpa (14)
Pinus ponderosa (6)

DACRYMYCES ENATUS (Berk. & Curt.) L. Kennedy

Alnaster fruticosa (19)
Alnus incana (2, UBC)
Alnus sp. (1, 19)
Citrus limonum (17)
Ligustrum sp. (19)
Quercus sp. (1, 19)
Pinus resinosa (UBC)
Pinus strobus (2)

DACRYMYCES ESTONICUS Raitv.

Picea sp. (18)
Pinus sp. (18, 19)

DACRYMYCES FUSCOMINUS Coker

Quercus sp. (20)

DACRYMYCES LACRYMALIS ((Pers.) S.F. Gray) Sommer

Quercus mirbeckii (17)

DACRYMYCES MACNABII Reid

Pinus sylvestris (19)

DACRYMYCES MICROSPORUS Karst.

Abies amabilis (UBC)
Pinus sylvestris (17)

DACRYMYCES MINOR Peck

Acer macrophyllum (12, UBC)
Alnus rubra (12, UBC)
Betula sp. (12, UBC)

Ligustrum sinense (20)
Machera pomifera (20)
Malus sp. (1)
Populus sp. (3, 20)
Quercus sp. (20, UBC)
Salix sp. (3)
Ulmus sp. (1)

Pinus contorta (12, UBC)
Pinus sylvestris (19)
Pinus sp. (UBC)
Thuja plicata (12, UBC)

Prosopis juliflora (7)

DACRYMYCES MINUTUS (L. Olive) McNabb

Vaccinium sp. (UBC)
Abies amabilis (UBC)
Picea glauca (UBC)
Pinus contorta (12, UBC)
Pseudotsuga menziesii (UBC)
Symplocos crateagoides (9)

DACRYMYCES OVISPORUS Bref.

Picea sp. (5)
Pinus sylvestris (19)
Taxus brevifolia (12, UBC)

DACRYMYCES PALMATUS (Schw.) Bres.

Banksia serrulata (UBC)
Betula sp. (12, UBC)
Quercus serrata (UBC)
Populus trichocarpa (UBC)
Abies grandis (12, UBC)
Abies sp. (9, 20)
Larix laricina (19)
Larix sp. (9)
Picea engelmannii (15)
Picea glauca (12, 15)
Picea mariana (15)
Pinus ponderosa (6)
Pinus sylvestris (17, 19)
Pinus toeda (UBC)
Pinus sp. (9, 20, UBC)
Pseudotsuga menziesii (20, UBC)
Thuja plicata (UBC)
Tsuga canadensis (19)

DACRYMYCES PEDUNCULATUS (Berk. & Curt.) CokerPinus sp. (3)DACRYMYCES PUNCTIFORMIS Neuh.Picea engelmannii (15)Picea sp. (9, 19)Pinus contorta (20)Pinus ponderosa (6)Pinus strobus (2)Pinus sp. (5, 19, UBC)DACRYMYCES STILLATUS Nees:Fr.Acer macrophyllum (12, UBC)Acer sp. (UBC)Alnus rubra (12, UBC)Eucalyptis sp. (20)Fagus sylvatica (17)Ilex aquifolium (17)Populus tremuloides (11)Populus trichocarpa (12, UBC)Quercus alba (20)Quercus suber (17)Quercus sp. (17, 20)Rubus spectabilis (12, UBC)Sambucus pubens (UBC)Sambucus racemosa (12)Sambucus sp. (UBC)Abies alba (17)Abies grandis (20)Juniperus virginiana (20)Larix eruopaea (17)Larix occidentalis (20)Picea excelsa (17)Picea sitchensis (UBC)Pinus contorta (20)Pinus strobus (20)Pinus sylvestris (17)Pinus sp. (3, 5, 20)Sequoia gigantea (20)Thuja plicata (12, UBC)Tsuga canadensis (20)Tsuga heterophylla (12, UBC)DACRYMYCES SUECIUS McNabbPinus halepensis (17)

DACRYMYCES VARIISPORUS McNabbPicea sp. (19)DACRYONAEMA RUFUM (Fr. per Fr.) Nannf.Abies sp. (16)Picea sp. (16)Pinus contorta (UBC)Pinus sp. (5, 16, UBC)DACRYOPINAX ELEGANS (Berk. & Curt.) MartinSambucus sp. (1)Ulmus sp. (1, 20)Juniperus communis (20)DACRYOPINAX SPATHULARIA (Schw.) MartinAcer rubra (2)Betula lutea (20)Castanea dentata (20)Citrus aurantium (17)Fagus grandifolia (20)Malus sp. (UBC)Quercus sp. (1, 20, UBC)Salix sp. (UBC)Tilia sp. (20)Juniperus virginiana (20)Pinus sylvestris (17)Pinus sp. (20)DITTIOLA RADICATA (Berk. & Curt.) L. KennedyAcrostaphylos columbiana (UBC)Alnus rubra (UBC)Betula sp. (20)Fagus sylvatica (17)Quercus sp. (UBC)Salix sp. (UBC)Vitis labrusca (20)Picea excelsa (17)Pinus strobus (UBC)Pinus sylvestris (17, 19)Pinus sp. (5, 20)Pseudotsuga menziesii (12)Tsuga canadensis (20)Tsuga heterophylla (12)

FEMSJONIA PEZIZAEFORMIS (Lev.) Karst.

Alnus incana (3, 17)
Betula lutea (3, UBC)
Betula pubescens (17)
Betula verrucosa (17)
Betula sp. (19)
Corylus sp. (UBC)
Quercus sp. (17, 19)

Tsuga heterophylla (12)

GUEPINIOPSIS BUCCINA (Pers.:Fr.) L. Kennedy

Alnus sp. (19)
Carpinus sp. (19)
Fagus sp. (19)
Quercus ilex (17)
Quercus sp. (17, 19)
Salices anonymae (17)
Salix sp. (19)
Ulex sp. (19)

Juniperus sp. (2)
Pinus strobus (2)

HETEROTEXTUS ALPINUS (Tracy & Earle) Martin

Alnus rubra (12, UBC)
Abies lasiocarpa (12, UBC)
Abies sp. (UBC)
Larix kaempferi (9)
Picea engelmannii (15, 20)
Picea shasta (UBC)
Pinus ponderosa (6)
Pinus sylvestris (19)
Pinus sp. (20)
Pseudotsuga menziesii (12, UBC)
Tsuga heterophylla (12)
Tsuga metensiana (12)

HETEROTEXTUS LUTEUS (Bres.) McNabb (as Guepiniopsis chrysocoma (Bull.:Fr.) Brasf.)

Abies amabilis (12)
Abies sp. (UBC)
Picea sp. (UBC)
Pinus sp. (20)
Tsuga heterophylla (12, UBC)

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APPENDIX 3:

COLLECTION DATA FOR SPECIMENS USED FOR CULTURING

All collections were made and determined by myself unless otherwise noted. Specimens for KAS, RJB and JAM numbers are in UBC. RJB=R.J. Bandoni. JAM=J. Andrew MacKinnon.

Calocera cornea KAS 83 (UBC 6151): Aug. 31, 1981, Parkridge woods, Sudbury, Ontario, on Populus or Acer.

Calocera cornea KAS 84 (UBC 6152): Aug. 16, 1981, Turkey Run State Park, Indiana, on hardwood. Coll. KAS & JAM.

Calocera cornea KAS 85 (UBC 6153): Aug. 12, 1981, Lake Itaska State Park, Minnesota, on hardwood. Coll. KAS & JAM.

Calocera cornea KAS 122 (UBC 6169): Aug. 9, 1981, NW side of Laing Island, Madang Province, Papua-New Guinea. Coll. G.C. Hughes III.

Calocera lutea RJB 6783 (UBC 6150): Aug. 15, 1981, Creek near Cameron's Camp, Hastings Forest, NSW Australia. Coll. RJB.

Calocera viscosa KAS 99 (UBC 6154): Sept. 23, 1981, Salish Trail, UBC Endowment Lands, Vancouver, B.C. on softwood. Coll. JAM.

Calocera viscosa KAS 117 (UBC 6168): Oct. 17, 1981, Pasatan Creek, B.C. Coll. Paul Kroeger.

Cerinomyces canadensis KW 2525 (UBC 6094): Nov. 21, 1978, Brandywine Falls, B.C. on Pseudotsuga menziesii. Coll. & Det. Ken Wells.

Cerinomyces ceraceus HHB 8968 (UBC 6160): April 5, 1976, Choctaw Circle Basin, Harrison Exp. Forest Rd. H5, Desoto National Forest, Harrison County, Mississippi, on Magnolia grandiflora. Coll. H.H. Burdsall, Jr. Det. J. Ginns. Obtained from Central Experimental Farm, Ottawa.

Cerinomyces crustulinus UBC 6108: Nov. 22, 1979, UBC campus, Vancouver, B.C.. Coll. RJB. Det. JAM.

Dacrymyces capitatus KAS 88 (UBC 6142): Aug. 30, 1981, Secord Rd. south of Sudbury, Ontario on ?Populus tremuloides.

Dacrymyces capitatus KAS 89 (UBC 6143): Aug. 30, 1981, Killarney Rd. south of Sudbury, Ontario.

Dacrymyces capitatus KAS 90 (UBC 6144): Aug. 22, 1981, Pinery Provincial Park, Ontario, on Quercus. Coll. KAS, JAM & N. More.

Dacrymyces dictyosporus RLG 10713 (UBC 6121): Aug. 18, 1972, Turkey Creek, Chiricahua Mountains, Coronado National Forest, Cochise County, Arizona, on Pinus engelmannii. Coll. & Det. R.L. Gilbertson. Obtained from Forest Products Laboratory, Madison, Wisconsin.

Dacrymyces dictyosporus HC 45 (UBC 6149): May 22, 1981, Valle de Brano, road to Tenescalpan, State of Mexico, Mexico. Coll. H. de la Cueva.

Dacrymyces minor KAS 18 (UBC 6177): Sept. 27, 1980, Cades Cove, SW of Gattinsburg, Tenn. Coll. J. & L. DeLange.

Dacrymyces minutus UBC 6175: Nov. 18, 1981, Wreck Beach, Vancouver, B.C. on conifer. Coll. KAS & H. de la Cueva.

Dacrymyces novae-zelandiae KAS 111 (UBC 6167): June 29, 1981, Mill Bay, Auckland, New Zealand. Coll. P.R. Johnston & E. Horak

Dacrymyces palmatus RLG 5853 (UBC 6120): June 24, 1966, Echo Lake, Flathead National Forest, Montana, on Abies grandis. Coll. & Det. R.L. Gilbertson. Obtained from Forest Products Laboratory, Madison, Wisconsin

Dacrymyces palmatus F3521 (UBC 6166): Aug. 30, 1933, Fairy Lake near Hull, Quebec, on conifer, Coll. J.W. Groves. Obtained from Central Experimental Farm, Ottawa.

Dacrymyces palmatus KW#50. date unknown. California. Coll. Weinstock 2. Monosporous cultures obtained from K. Wells.

Dacrymyces palmatus KAS 13 (UBC 6170): Oct. 4, 1980, Sesquicentennial Park, Columbia, South Carolina, Coll. J. & L. DeLange.

Dacrymyces palmatus KAS 17: same as D. minor KAS 18.

Dacrymyces palmatus KAS 22 (UBC 6176): same as D. minor KAS 18.

Dacrymyces palmatus KAS 113 (UBC 6148): Sept. 22, 1981, Honey Harbour, Ontario, on hemlock. Coll. R.C. Shipman.

Dacrymyces punctiformis HHB 671 (UBC 6124): June 17, 1968, Greenbelt Park, Greenbelt, Maryland. Coll. H.H. Burdsall, Jr. Det. K.K. Nakasone. Obtained from Forest Products Laboratory, Madison, Wisconsin.

Dacrymyces stillatus KAS 2: Sept. 11, 1980, near Anthropology Museum, UBC campus, Vancouver, B.C. on Acer.

Dacrymyces stillatus KAS 100 (UBC 6145): Sept. 30, 1981, UBC Endowment Lands, Vancouver, B.C.

Dacrymyces stillatus KAS 101 (UBC 6146): same as KAS 100.

Dacrymyces stillatus KAS 103 (UBC 6147): same as KAS 100.

Dacrymyces stillatus KW 2876. Coll. by K. Wells, West Germany, Wells culture # 228, monosporous cultures obtained from K. Wells.

Dacryopinax spathularia RJB 6424 (UBC 6101): June 1979, Lyon Arboretum, Honolulu, Hawaii. Coll. & Det. RJB.

Dacryopinax spathularia FP 101783 (UBC 6126): Sept. 27, 1980, Merrill Springs Rd., Dane County, Madison, Wisconsin, on Malus sp. Coll. F.F. Lombard. Det. H.H. Burdsall, Jr. Obtained from Forest Products Laboratory, Madison, Wisconsin.

Dacryopinax spathularia UBC 6171 and monokaryons: Louisiana State University, Baton Rouge, La., on lid of wooden trash can. Coll. B. Lowy, Meredith Blackwell. Det. B. Lowy.

Heterotextus luteus KAS 50 (UBC 6165): May 8, 1981, UBC Research Forest, Haney, B.C. on Douglas fir.