

原 著

OCCURRENCE OF MYXOMYCETES IN RELATION TO THE DECAYING STATE OF *PINUS DENSIFLORA* AND *QUERCUS ACUTISSIMA*

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ABSTRACT

The succession of Myxomycetes on decaying wood has not been fully investigated. In the summer of 1998, I found that Myxomycetes occurred in relation to the decaying state of *Pinus densiflora* and *Quercus acutissima* in pine-oak community forests of southwest Japan. I surveyed 342 colonies on decaying *P. densiflora* and 109 colonies on shiitake-cultivating wood logs of *Q. acutissima* under natural conditions.

Myxomycetes of 33 taxa belonging to 14 genera were found on *P. densiflora* and 16 taxa belonging to 8 genera on *Q. acutissima*. The dominant species on *P. densiflora* were different from those on *Q. acutissima*. Species of Cribariaceae belonging to Liceales were dominant on the pine, and species of Trichiales and Stemonitales were dominant on the oak.

Both the pine and oak results demonstrated that as the wood decayed the species changed. On slightly decayed wood a few taxa appeared. On softer and more decayed wood, the number of species and area of occurrence increased, but on the softest and most decayed wood, only a few species appeared. On the pine, species of *Physarum* appeared on hard wood, and Cribariaceae appeared on well decayed wood. On the oak, Trichiales and Stemonitales appeared on crumbling wood. *Physarum* found on the hard wood changed into different characteristic species in relation to the decaying state.

This data indicates that species of Myxomycetes found on slightly decayed wood are different from those found on well-decayed wood and occur in relation to the decaying state of the wood.

Key words : Decaying state of wood, Myxomycetes, *Pinus densiflora*, *Quercus acutissima*.

Introduction

Myxomycetes are common inhabitants of decaying wood in forests throughout the world. Fallen timber provides a substrate for the more conspicuous species. As wood decays, the feeding conditions for myxamoeba and plasmodia are likely to change. However, no systematic study has been made on the succession of myxomycetes on decaying wood.

The purpose of this study (which was conducted in

the summer of 1998) was to investigate how Myxomycetes occurs in relation to the decaying state of *Pinus densiflora* and *Quercus acutissima*. In the southwest parts of Japan, the peak time for the seasonal appearance of fruiting bodies corresponds with the hot and humid summer, i.e. from June to early September (K. Takahashi 1996, S. Hamashima 1964).

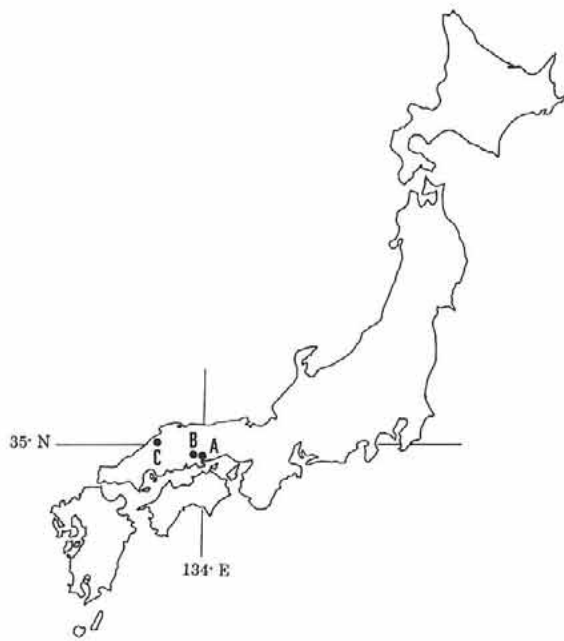


Figure 1. Location of study sites.

The three study sites selected contained the same kind of secondary forest, in which the major species were pine and chestnut oak (*Quercus* spp.) A: Misaoyama Hill, Okayama city, Okayama Prefecture (latitude 34° 39' N, longitude 133° 57' E, elevation 140m), B: Yoshikawa, Kayo-cho, Okayama Prefecture (latitude 34° 49' N, longitude 133° 46' E, elevation 380m), C: Kawai, Oda city, Shimane Prefecture (latitude 34° 49' N, longitude 133° 46' E, elevation 380m).

Methods

Three study sites (Fig. 1) contained the same kind of secondary forest, in which the major species were pine and chestnut oak (*Quercus* spp.). A: Misaoyama, Okayama city, Okayama Prefecture (latitude 34° 39' N, longitude 133° 57' E, elevation 140m) B: Yoshikawa, Kayo-cho, Okayama Prefecture (latitude 34° 49' N, longitude 133° 46' E, elevation 380m) C: Kawai, Oda city, Shimane Prefecture (latitude 34° 49' N, longitude 133° 46' E, elevation 380m)

This survey examined myxomycetes on two different kinds of fallen dead wood, *Pinus densiflora* and *Quercus acutissima*, which were once used for shiitake cultivation under natural conditions in the pine-oak community forest (Fig. 2). These pieces of

wood had an approximate diameter of 15cm to 30cm.

The size of the fruiting area (cm²) was measured, and then the hardness of the wood was estimated using a soil hardness tester (Takemura electric works, LTD) to identify the state of decay.

I surveyed 342 colonies on decaying *P. densiflora* and 109 colonies on shiitake-cultivating wood logs of *Q. acutissima*. The colonies were collected in the field and then identified by observation using a microscope in the laboratory. Identification was made by the monograph of Y. Yamamoto (1998).

I determined the total area and number of colonies of each species, and calculated the total area of all species and total number of colonies. I then determined the percentage of each species based on the total colony coverage and number of colonies.

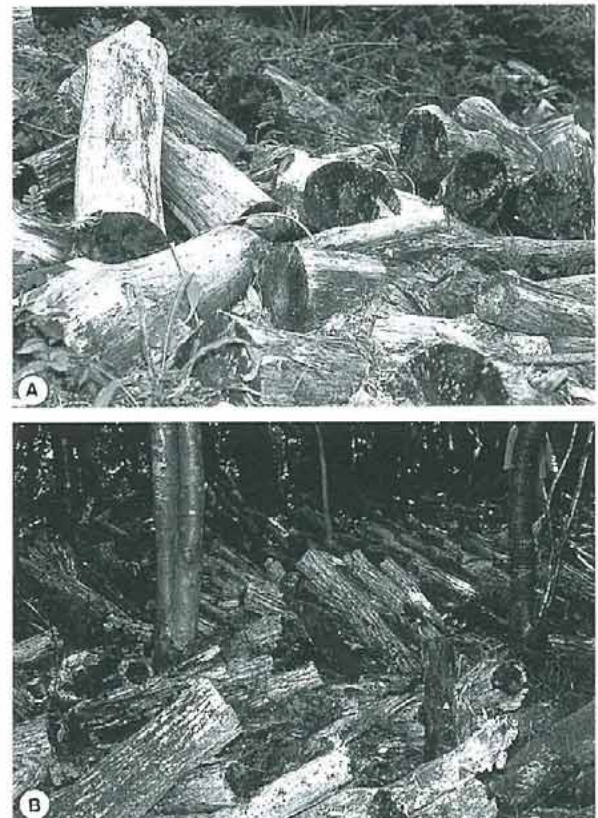


Figure 2. Study area.

A: Decaying wood of *Pinus densiflora* in the pine-oak community forest. B: Logs of *Quercus acutissima* were once used for shiitake-cultivation in the pine-oak community forest.

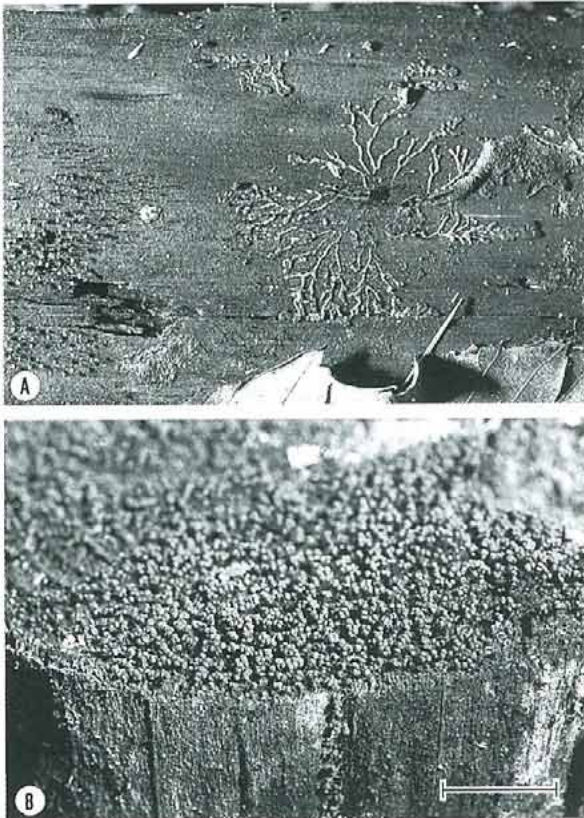


Figure 3. Plasmodia and a colony of fruiting bodies of Myxomycetes on the decaying wood. A: Plasmodia of *Cribraria* migrated to the surface of *Pinus densiflora* after developing inside the wood. B: The dominant species on *Pinus densiflora* was *Cribraria cancellata*. The scale shows 2 cm.

Results and Discussion

After the plasmodia had grown inside the wood, they crawled out to the surface and fruited. One fruiting body was from a few mm to several cm's in size, but the colony was from a few square centimeters to several hundred centimeters in area (Fig.3).

On *P. densiflora*, Myxomycetes of 33 taxa belonging to 14 genera were identified from 342 colonies (Table 1). The dominant species were *Cribraria cancellata*, *C. tenella*, *Physarum flavicomum*, and *Ceratiomyxa fruticulosa*. Five species belonging to *Cribraria* occupied 64% of the total coverage and 19% occurrence of the total colonies.

On *Q. acutissima*, Myxomycetes of 16 taxa belonging to 8 genera were identified from 109 colonies (Table 3). The dominant species were *Arciria cinerea*,

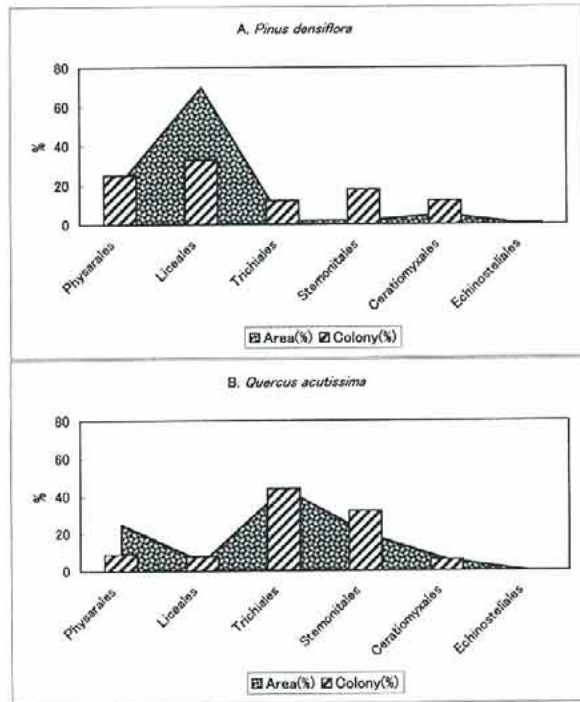


Figure 4. Percentage of colony area and occurrence of Myxomycetes on the decaying wood.

Physarum globuliferum, *Stemonitis axifera*, and *Hemitrichia clavata* var. *calyculata*. Three species belonging to Trichiales occupied 43% of the total coverage and 44% occurrence of the total colonies. Nine species belonging to Stemonitales occupied 20% of the total coverage and 34% occurrence of the total colonies.

The dominant species on the pine had different characteristics from those on the oak (Fig.4). Species of Cribrariaceae belonging to Liceales were dominant on the pine, and species of Trichiales and Stemonitales were dominant on the oak.

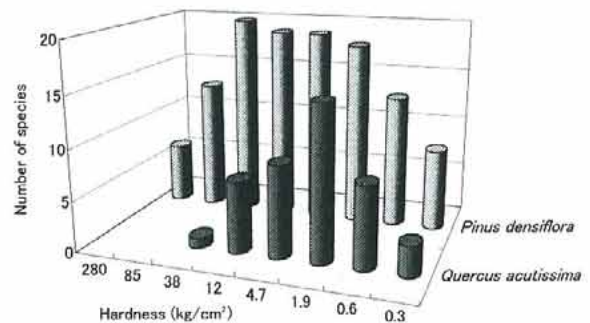


Figure 5. Number of species relating to the hardness of the wood.

Table 1. Myxomycetes on dead *Pinus densiflora*.

Taxa occurred	Area (cm ²)	No. colonies	% of area	% of colony	Average area of colony (cm ²)
Liceales					
1 <i>Cribraria cancellata</i>	5724	33	44	10	173
2 <i>Cribraria intricata</i>	654	9	5	2	73
3 <i>Cribraria languescens</i>	350	6	3	2	58
4 <i>Cribraria splendens</i>	4	2	0	1	2
5 <i>Cribraria tenella</i>	1483	15	12	4	99
6 <i>Enteridium lycoperdon</i>	24	3	0	1	8
7 <i>Lindbladia cribrarioides</i>	300	3	2	1	100
8 <i>Lindbladia tubulina</i>	167	6	1	2	28
9 <i>Lycogala epidendrum</i>	333	34	3	10	10
10 <i>Lycogala exiguum</i>	1	1	0	0	1
Trichiales					
11 <i>Arcyria cinerea</i>	175	20	1	6	9
12 <i>Arcyria denudata</i>	1	1	0	0	1
13 <i>Arcyria insignis</i>	1	1	0	0	1
14 <i>Arcyria obvelata</i>	75	18	1	5	4
Stemonitales					
15 <i>Collaria arcyronema</i>	64	9	0	3	7
16 <i>Enerthenema papillatum</i>	9	3	0	1	3
17 <i>Stemonitis axifera</i>	49	26	0	8	2
18 <i>Stemonitis axifera</i> var. <i>smithii</i>	1	1	0	0	1
19 <i>Stemonitis flavogenita</i>	1	1	0	0	1
20 <i>Stemonitis fusca</i>	106	10	1	3	11
21 <i>Stemonitis splendens</i>	37	3	0	1	12
22 <i>Stemonitopsis hyperopta</i>	1	2	0	1	1
23 <i>Stemonitopsis typhina</i> var. <i>similis</i>	5	8	0	2	1
Physarales					
24 <i>Diderma deplanatum</i>	1	1	0	0	1
25 <i>Fuligo candida</i>	15	1	0	0	15
26 <i>Fuligo septica</i>	224	9	2	3	25
27 <i>Physarum flavicomum</i>	1501	30	12	9	50
28 <i>Physarum globuliferum</i>	466	5	4	1	93
29 <i>Physarum nutans</i>	66	9	1	3	7
30 <i>Physarum roseum</i>	40	7	0	2	6
31 <i>Physarum viride</i>	366	23	3	7	16
Ceratiomyxales					
32 <i>Ceratiomyxa fruticulosa</i>	624	40	5	12	16
Echinosteliales					
33 <i>Clastoderma debaryanum</i>	12	2	0	1	6
Total	12875	342	100	100	

Zero shows a value below 0.5.

Table 2. Percentage of colony area on *Pinus densiflora* relating to the hardness of the wood.

Taxa occurred	Class of hardness (kg/cm ²)								Total %
	280	85	38	12	4.7	1.9	0.6	0.3	
Liceales									
1 <i>Cribraria cancellata</i>				9	41	23	12	15	100
2 <i>Cribraria intricata</i>				47		51	2		100
3 <i>Cribraria languescens</i>					2	96	2	1	100
4 <i>Cribraria splendens</i>						50		50	100
5 <i>Cribraria tenella</i>					16	40	43	1	100
6 <i>Enteridium lycoperdon</i>		100							100
7 <i>Lindbladia cribrarioides</i>					67	8	25		100
8 <i>Lindbladia tubulina</i>				8	76	16			100
9 <i>Lycogala epidendrum</i>	2	9	7	33	15	30	2	2	100
10 <i>Lycogala exiguum</i>		100							100
Trichiales									
11 <i>Arcyria cinerea</i>			13	30	6	13	37		100
12 <i>Arcyria denudata</i>			100						100
13 <i>Arcyria insignis</i>			100						100
14 <i>Arcyria obvelata</i>		32	29	3	28	4	4		100
Stemonitales									
15 <i>Collaria arcyrionema</i>		63	20	8		6	3		100
16 <i>Enerthenema papillatum</i>			50	50					100
17 <i>Stemonitis axifera</i>	51	6	6	15	13	9			100
18 <i>Stemonitis axifera</i> var. <i>smithii</i>		100							100
19 <i>Stemonitis flavogenita</i>			100						100
20 <i>Stemonitis fusca</i>			44	4		52			100
21 <i>Stemonitis splendens</i>				30	70				100
22 <i>Stemonitopsis hyperopta</i>					100				100
23 <i>Stemonitopsis typhina</i> var. <i>similis</i>			8	8	18		8	60	100
Physarales									
24 <i>Diderma deplanatum</i>		100							100
25 <i>Fuligo candida</i>			100						100
26 <i>Fuligo septica</i>	1			14		80	5	1	100
27 <i>Physarum flavicomum</i>	14	11	29	12	33				100
28 <i>Physarum globuliferum</i>			74		26				100
29 <i>Physarum nutans</i>	50	12	4	6	4	24			100
30 <i>Physarum roseum</i>			46	50	4				100
31 <i>Physarum viride</i>	6	41	5	8	6	25	9		100
Ceratiomyxales									
32 <i>Ceratiomyxa fruticulosa</i>		2	22	4	8	4	3	57	100
Echinosteliales									
33 <i>Clastoderma debaryanum</i>			75			25			100

Table 3. Myxomycetes on dead *Quercus acutissima*.

Taxa occurred	Area (cm ²)	No. colonies	% of area	% of colony	Average area of colony (cm ²)
Liceales			5		
1 <i>Lycogala epidendrum</i>	454	9	5	8	50
Trichiales					
2 <i>Arcyria cinerea</i>	3011	11	35	10	274
3 <i>Arcyria denudata</i>	468	14	5	13	33
4 <i>Hemitrichia clavata</i> var. <i>calyculata</i>	294	23	3	21	13
Stemonitales					
5 <i>Collaria arcyrionema</i>	1	1	0	1	1
6 <i>Stemonitis axifera</i>	1021	11	12	10	93
7 <i>Stemonitis axifera</i> var. <i>smithii</i>	25	1	0	1	25
8 <i>Stemonitis fusca</i>	320	6	4	6	53
9 <i>Stemonitis pallida</i>	1	1	0	1	1
10 <i>Stemonitopsis gracilis</i>	79	4	1	4	20
11 <i>Stemonitopsis hyperopta</i>	61	4	1	4	15
12 <i>Stemonitopsis typhina</i>	50	1	1	1	50
13 <i>Stemonitopsis typhina</i> var. <i>similis</i>	126	6	1	6	21
Physarales					
14 <i>Physarum globuliferum</i>	2146	10	25	9	215
Ceratiomyxales					
15 <i>Ceratiomyxa fruticulosa</i>	458	4	5	4	115
16 <i>Ceratiomyxa fruticulosa</i> var. <i>descendens</i>	61	3	1	3	20
Total	8575	109	100	100	

Zero shows a value below 0.5.

Table 4. Percentage of colony area on *Quercus acutissima* relating to the hardness of the wood.

Taxa occurred	Class of hardness (kg/cm ²)							Total %
	85	38	12	4.7	1.9	0.6	0.3	
Liceales								
1 <i>Lycogala epidendrum</i>				17	2	81		100
Trichiales								
2 <i>Arcyria cinerea</i>			24	0	3	72		100
3 <i>Arcyria denudata</i>			58	0	34	7		100
4 <i>Hemitrichia clavata</i> var. <i>calyculata</i>			5	74	9	10	1	100
Stemonitales								
5 <i>Collaria arcyrionema</i>					100			100
6 <i>Stemonitis axifera</i>			2	7	15	76		100
7 <i>Stemonitis axifera</i> var. <i>smithii</i>					100			100
8 <i>Stemonitis fusca</i>		50		19	12			100
9 <i>Stemonitis pallida</i>						100		100
10 <i>Stemonitopsis gracilis</i>				82	18			100
11 <i>Stemonitopsis hyperopta</i>			49	49	2			100
12 <i>Stemonitopsis typhina</i>					100			100
13 <i>Stemonitopsis typhina</i> var. <i>similis</i>					70		30	100
Physarales								
14 <i>Physarum globuliferum</i>			12	9	79			100
Ceratiomyxales								
15 <i>Ceratiomyxa fruticulosa</i>			1		20	79		100
16 <i>Ceratiomyxa fruticulosa</i> var. <i>descendens</i>					74		26	100

Zero shows a value below 0.5.

Relation to the decaying state of wood

In both kinds of wood, only a few taxa appeared (on slightly decayed wood), but on softer and more decayed wood, the number of species increased. On the softest wood, only a few species were found (Fig.5).

On the hard wood (a little decomposed) of *P. densiflora*, a few taxa appeared, such as *Physarum flavicomum*, *P. nutans* and *P. viride*. On the softest and most decayed wood, only a few species were dominant, such as *Cribraria cancellata*, *C. tenella*, and *Ceratiomyxa fruticulosa* (Table 2).

On the *Quercus*, the species found on slightly decayed wood were also different from those on the well-decayed wood. On firm wood, species of *Stemonitis fusca* were found, and on crumbling wood, species such as *Stemonitis axifera*, *Stemonitopsis*

typhina and *Ceratiomyxa fruticulosa*, were found (Table 4).

The area percentage of each order on the pine and oak showed a remarkable contrast in relation to the hardness of wood. On the pine, Physarales appeared on hard wood and then changed to Liceales when the wood was softer (Fig. 6). However, on the oak, the Myxomycetes changed into Physarales with Stemonitales and Trichiales as the wood decayed (Fig. 7).

Both the *P. densiflora* and *Q. acutissima* results demonstrated that as the wood decayed the species changed. On *P. densiflora*, species of *Physarum* appeared on hard wood, but Cribrariaceae appeared on well-decayed wood. On *Q. acutissima*, Trichiales and Stemonitales appeared on crumbling wood.

The data showed that *Physarum* found on the hard wood changed into different species in relation to the state of decay. Species of Myxomycetes found on slightly decayed wood were different from those found on well-decayed wood.

It has been said that in lignicolous species, the fruiting bodies are usually found on the surface of the same material on which they have been feeding (B. Ing 1994). The hardness in the part of wood containing fruiting bodies was affected by internal decaying. As the decaying increases, the food for the plasmodia that take on the role of scavengers may become different. The size of the colonies were associated with the amount of available food inside of the wood for the plasmodia fertilizing. Therefore, the hardness of wood and colony size may show the feeding environment for Myxomycetes on the decaying wood.

This study is the first report on the succession of myxomycetes on decaying wood. However, much more work is needed to correlate the occurrence of myxomycetes with the state of decay.

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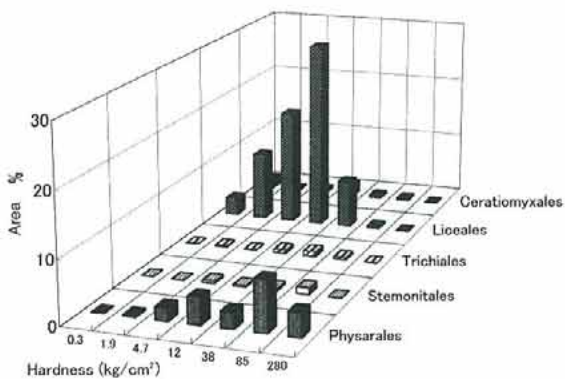


Figure 6. Area percentage of each order on *Pinus densiflora* relating to the hardness of the wood.

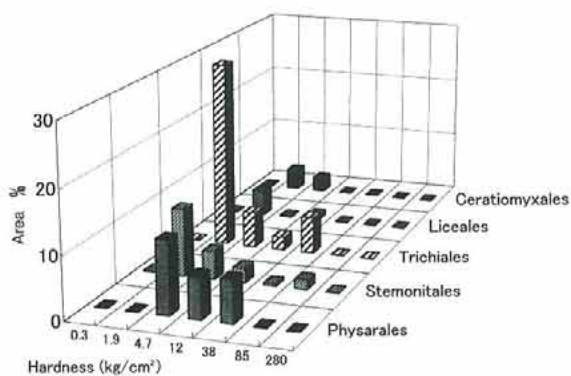


Figure 7. Area percentage of each order on *Quercus acutissima* relating to the hardness of the wood.

and helpful comments.

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二次林における変形菌の発生と倒木の腐朽状態の関係

高橋 和成

変形菌は、アメーバや変形体の段階で細菌の摂食や栄養物質の吸収によって増殖する。腐朽木は、多様な変形菌の生活の場となるため、変形菌の発生はその腐朽状態に関係すると考えた。1998年の夏に岡山県賀陽町の吉備高原と岡山市操山や島根県大田市の二次林内で、アカマツとクヌギの腐朽木に出現する変形菌を観察し、倒木の腐朽と変形菌の着生の関係について調べた。

直径15cm以上の倒木に出現した変形菌のコロニーの面積を求め、それが着生した部位の硬さを中山式土壤硬度計で測定した。アカマツ腐朽木では342コロニーを観察し、クヌギでは109コロニーを観察した。

アカマツ腐朽木には14属31種2変種が出現し、クヌギには8属12種4変種が出現した。アカマツのあまり腐朽していない硬い倒木上には、*Physarum flavicomum* Berk., *P. viride* (Bull.) Pers.などの6種が出現した。やや腐朽した倒木には19種類の変形菌が出現し、それらの発生面積も大きくなった。しかし、材が十分に腐朽して柔らかくなると出現種は8種に減少し、*Cribraria cancellata* (Batsch) Nann.-Bremek., *C. tenella* Schrad., *Ceratiomyxa fruticulosa* (Mueller) T.Macbr.などの種が出現した。クヌギでは優占する種がアカマツとは異なっていたが、材が腐朽すると出現種が15種まで増加した。*Physarum globuliferum* (Bull.) Pers., *Hemitrichia clavata* var. *calyculata* (Speg.) Y. Yamam., *Arcyria denudata* (L.) Wettst.などが材の硬さに関係して出現した。2種類の倒木において、あまり腐朽していない倒木では子実体に石灰質を含むPhysaralesの種が優占し、腐朽して柔らかくなった倒木では、非石灰性種の*Cribraria*などのLicealesの種、あるいはTrichialesの種が優占した。