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Myxomycetes associated with the aerial litter microhabitat in a temperate deciduous forest during winter

Steven L. Stephenson[1] and Barbara C. Stephenson[2]

[1] Department of Biological Sciences, University of Arkansas, Fayetteville, Arkansas 72701, USA
[2] Department of Mathematics, University of Arkansas, Fayetteville, Arkansas 72701, USA

E-mail: slsteph@uark.edu

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Abstract: Aerial litter as a microhabitat for myxomycetes is relatively uncommon in temperate deciduous forests, but these organisms can be isolated from the examples that do exist. Samples of aerial litter collected during winter when the foliage of virtually all plants in the forest is dead yielded numbers of species and records that were comparable to those obtained for samples collected during summer when the foliage of plants present is living. However, there was very little overlap in the data obtained for the two different seasons, with only four of 16 species shared in common.

Keywords: ecology, mixed oak forest, moist chamber cultures, slime molds, southwestern Virginia

Introduction

Aerial litter has been defined as dead but still attached plant parts that have never been in contact with the ground (Stephenson and Spooner 1997, Black et al. 2004, Stephenson et al. 2004). This microhabitat is well represented in tropical forests but relatively uncommon in temperate deciduous forests (Stephenson and Stephenson 2022). The occurrence of myxomycetes (plasmodial slime molds or myxogastrids) in the aerial litter microhabitat is well established, with most of the information derived from studies carried out in tropical forests (e.g., Black et al. 2004). Stephenson and Stephenson (2022) obtained data on the myxomycetes associated with the aerial litter microhabitat in a temperate deciduous forest in the mountains of southwestern Virginia. They also assessed the differences in the assemblages present on aerial litter from herbaceous plants as opposed to aerial litter from woody plants. The samples they processed were collected in early summer (late May/early June) when the foliage of virtually all the plants present was living.

The purposes of the study reported herein were (1) to characterize the assemblage of myxomycetes associated with each type of aerial litter in a temperate deciduous forest during the winter when the foliage of virtually all the plants is dead (Fig. 1), (2) to assess differences in the assemblages of species associated with the two types of aerial litter microhabitats in winter, and (3) to compare the assemblages of the species present on aerial litter in the two different seasons of the year.

Figure 1. General aspect of a temperate deciduous forest during winter.

Materials and methods

On December 20 of 2021, twenty samples of aerial litter (consisting of dead leaves in each instance) were collected in the general vicinity of the University of Virginia Mountain Lake Biological Station (38.0342°N, 78.5120°W; elevation 1,160 m) in the mountains of southwestern Virginia. The forest from which samples were collected is mixed oak, with northern red oak (*Quercus rubra* L.) and white oak (*Q. alba* L.) the dominant species present. Ten of the samples consisted of dead leaves collected from herbaceous plants, whereas the other ten samples consisted of dead leaves from woody plants.

Herbaceous plants providing the dead leaves were goldenrod (*Solidago* spp.), wood aster (*Aster* sp.), broad-leaved panic grass (*Dichanthelium latifolium* [L.] Harvill), and interrupted fern (*Osmunda claytoniana* L.). Woody plants sampled were black oak (*Quercus velutina* Lam.), red oak (*Quercus rubra* L.), white oak (*Q. alba* L.), and American beech (*Fagus grandifolia* Ehrh.).

Each sample was placed in a small paper bag in the field, brought back to the Eumycetozoan Laboratory at the University of Arkansas, and processed in the manner described by Stephenson and Stempen (1994). In brief, pieces of dead leaves from each sample were placed in disposable plastic Petri dishes lined with filter paper, with enough material placed in each dish to cover most of the bottom. Later, water was added to each dish, the top placed on the dish, and what was now a moist chamber culture was set aside for approximately 24 hours. After this time, pH was determined for each culture with the use of a portable pH meter and then excess water was poured off. Three moist chamber cultures were prepared from each sample, for a total of 60 cultures (30 from herbaceous plants and 30 from woody plants). These cultures were examined with a stereomicroscope on a weekly basis for a period of three months. Specimens of myxomycetes appearing in the cultures were removed along with a small portion of the substrate upon which they occurred, allowed to air-dry, and then placed in small pasteboard boxes for permanent storage. All specimens cited herein are now deposited in the mycological herbarium (UARK) of the University of Arkansas.

Results

Forty (67%) of the 60 moist chamber cultures prepared with samples of aerial litter yielded evidence (either fruiting bodies or plasmodia) of myxomycetes. Samples of herbaceous aerial litter were slightly more productive (21/30 or 70%) than those of woody litter (19/30 or 63%) when numbers of positive cultures were considered. Nine species in seven genera were recorded. *Didymium difforme* (specimens appearing in 18 cultures) was clearly the most abundant species but occurred only on herbaceous aerial litter. In contrast, *Trichia favoginea* (six cultures) appeared only on woody aerial litter. *Stemonitis flavogenita* (four cultures) was the only other species recorded from at least two moist chamber cultures. Herbaceous litter yielded 25 specimens representing seven different species, whereas woody litter yielded nine specimens representing four different species.

Most of the myxomycetes appearing in a particular moist chamber culture were represented by only a few fruiting bodies, but this wasn't always the case. Many of the cultures prepared with samples of *Solidago* aerial litter produced more than 100 small fruiting bodies of *Didymium difforme*.

The mean pH of all moist chamber cultures was 6.1 (range = 4.8 to 7.2). The mean value for cultures prepared with herbaceous aerial litter was 6.5 (range = 6.2 to 7.2), which was slightly higher than the value recorded for woody litter (5.6, with a range of 4.8 to 6.2).

Annotated list of species

All species of myxomycetes recorded in the present study are listed alphabetically by genus and then species. The nomenclature used follows Lado (2005-2022). Information is provided on the total number of collections and the substrate (herbaceous and/or woody aerial litter) yielding the species in question. Collection numbers are those of the first coauthor.

Arcyria cinerea (Bull.) Pers.
Herbaceous aerial litter (one record, 34707)

Didymium difforme (Pers.) Gray
Herbaceous aerial litter (18 records, including 34708 and 34709)

Diderma effusum (Schwein.) Morgan
Herbaceous aerial litter (one record, 34675)

Hemitrichia serpula (Scop.) Rostaf. ex Lister
Herbaceous aerial litter (two records, including 34717)

Perichaena depressa Lib.
Herbacerous aerial litter (one record, 34678)

Stemonitis flavogenita E. Jahn
Herbaceous aerial litter (one record, 34716) and woody aerial litter (four records, including 34715)

Stemonitis herbatica Peck
` Woody aerial litter (one record, 34731)

Stemonitis nigrescens Rex (often considered as a synonym of *Stemonitis fusca* Roth)
Herbaceous aerial litter (one record, 34717) and woody aerial litter (one record, 34714)

Trichia favoginea (Batsch) Pers.
Woody aerial litter (six records, including 34722 and 34730)

Discussion

The present study provided additional data on the assemblage of myxomycetes associated with the aerial litter microhabitat in temperate deciduous forests, where this microhabitat is not nearly as abundant as is the case in tropical forests. Stephenson and Stephenson (2022) reported low levels of abundance and species richness for the assemblage of species recovered from samples collected during summer, when the foliage of the plants present is living and there is very little aerial litter available. In this earlier study, eleven species representing nine genera were recorded, and 65% of all moist chamber cultures yielded evidence (either plasmodia or fruiting bodies) of myxomycetes. As was also the case in the present study, samples of aerial herbaceous litter yielded more specimens and more species than woody aerial litter. Presumably, the former decomposes more quickly than the latter, and this probably is at least one factor that accounts for this difference.

In the present study, samples were collected during winter when the foliage of most of the plants present is dead and aerial litter is relatively abundant (Figure 1). Sixty-five percent of the moist chambers were positive for myxomycetes, and nine species in five genera were recorded. As such, the data from the two studies are rather comparable, although overall species richness was lower for samples collected in winter. Surprisingly, only four of 16 species compiled in the two studies were shared in common. Perhaps the most striking difference between the assemblages of myxomycetes associated with aerial litter in summer and winter is the presence of two species (*Hemitricha serpula* and *Trichia favoginea*) typically associated with coarse woody debris on ground sites (Alexopoulos and Martin 1969). There appears to be no obvious explanation as to why this is the case. Clearly, a number of as yet undetermined factors affect the composition of the assemblages of myxomycetes associated with aerial litter in temperate deciduous forests.

The pH of the microhabitat with which myxomycetes are associated is known to be a factor affecting their distribution in nature (Stephenson and Stempen 1994). Values of pH recorded for the sets of samples collected during winter and summer were fairly comparable, although those collected during winter were generally lower. The most noticeable difference existed for woody aerial litter, where the samples collected during summer had a mean pH of 6.4 and those collected during the winter a mean pH of 5.6.

In brief, the present study was limited in scope, but it points out the need for more extensive investigations of a microhabitat for myxomycetes that remains understudied. Although the aerial litter as a component of temperate deciduous forest ecosystems is rather limited in extent, it does support an assemblage of myxomycetes for which the composition changes from summer to winter.

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