A COPROPHILOUS FRUITING SEQUENCE ON EQUINE DUNG FROM ARMIDALE, NEW SOUTH WALES

S.P. McCarthy
63 Manor Road, Hornsby, N.S.W. 2077, Australia

ABSTRACT

Individual samples of freshly voided equine dung were incubated for 3, 7, 14, 21, 28 and 35 days. Following incubation, each sample was examined for fruit-bodies. In all, 26 genera comprising 8 Phycomycetes, 7 Discomycetes, 5 Pyrenomycetes and 6 Basidiomycetes sporulated. The onset of sporulation in a range of genera from these taxonomic groups was found to be similar between equine dung in the present study and rabbit, ostrich, angora goat, opossum and kangaroo dung described elsewhere. However, only the cessation of sporulation in several genera from the Discomycetes was found to be similar between equine dung and these substrata. The apparent succession of fruit-bodies by coprophilous fungi colonising equine dung from Australia is best explained by the definition of fungal succession proposed by Rayner & Todd (1979).

INTRODUCTION

The sequential change in the production of fruit-bodies by species of coprophilous fungi colonising a wide range of substrata has been well documented (*e.g.* Harper & Webster 1964; Webster 1970). To date, most descriptions of this phenomenon have been confined to the coprophilous mycoflora of the Northern Hemisphere (*e.g.* Dade 1957; Harper & Webster 1964); however, three exceptions to this are Mitchell (1970), Bell (1975) and Nagy & Harrower (1979).

In this report I compare the fruiting sequence of coprophilous fungi colonising equine dung from Australia with those fruiting sequences described by Harper & Webster (1964), Mitchell (1970), Bell (1975) and Nagy & Harrower (1979). I then attempt to interpret the fruiting sequence obtained in the present study by using two definitions of fungal succession proposed by Harper & Webster (1964) and Rayner & Todd (1979).

MATERIALS AND METHODS

Samples of freshly voided equine dung were collected from stables near Armidale, New South Wales (30°31'S, 151°39'E), and then placed in Petri dishes. Two sheets of sterile wet filter paper were placed in each dish, and a sample of dung was placed in the centre of the plate. A lid was then placed on each plate. Each plate was then incubated at 25°C under natural day and night light regimes for one of the following periods: 3 days; 7 days; 14 days; 21 days; 28 days; and 35 days. No water was added to the dung or filter paper of the plates at any time. Following incubation, the plates were examined under a dissecting microscope for any fruit-bodies. Single fruit-bodies were transferred aseptically to glass slides and stained with lactophenol cotton blue. The slides were sealed with nail-varnish. The fungi were identified using the dichotomous key of Brown & Ponter (1994).

RESULTS

The genera sporulating on equine dung

The genera of fungi that sporulated on each plate were recorded (Table 1). In all, 26 genera were recorded comprising 8 Phycomycetes, 7 Discomycetes, 5 Pyrenomycetes and 6 Basidiomycetes. The Zygomycetes included species of *Pilobolus*, *Mortierella*, *Cunninghamella*, *Pilaira*, *Rhizopus*, *Syncephalis*, *Mucor* and the mycoparasite *Piptocephalis*. The Ascomycetes included species of Discomycetes (*Cheilymenia*, *Lasiobolus*, *Ascobolus*, *Ascophanus*, *Saccobolus*, *Coprobia* and *Peziza*) and Pyrenomycetes (*Poronia*, *Sporormia*, *Sordaria*, *Podospora* and *Delitschia*). The Basidiomycetes were represented in part by species of *Bolbitius* and *Coprinus*.

The sequence of onset of sporulation in the Zygomycetes, Ascomycetes and Basidiomycetes on equine dung

The onset of sporulation in the Phycomycetes was denoted by the appearance of sporangiophores of *Pilobolus* at three days. Species of four genera, including *Pilaira* and *Piptocephalis*, then sporulated for the first time at seven days and were followed by species of two additional genera (*Rhizopus* and *Syncephalis*) at 14 days and

one (*Mucor*) at 35 days. Thus an initial flush of Phycomycetes occurred during the first seven days of the experiment. During this time, the dung was moist.

Table 1. Days to sporulation in genera occurring on incubated samples of equine dung from Armidale, New South Wales. (An asterisk indicates presence of at least one fruit-body)

	3 days	7 days	14 days	21 days	28 days	35 days
Zygomycetes						
Pilobolus spp.	*	*	*			
Mortierella spp.		*				
Cunninghamella spp.		*				
Pilaira spp.		*	*			
Piptocephalis spp.		*	*	*		
Rhizopus spp.			*			
Syncephalis spp.			*			
Mucor spp.						*
Ascomycetes						
Poronia spp.		*	*			
Cheilymenia spp.		*	*			
Lasiobolus spp.			*	*		
Ascobolus spp.			*	*		
Sporormia spp.			*		*	
Ascophanus spp.			*	*	*	
Saccobolus spp.			*	*	*	*
Coprobia spp.			*	*	*	*
Sordaria spp.			*	*	*	*
Podospora spp.				*	*	*
Peziza spp.					*	
Delitschia spp.						*
Basidiomycetes						
Bolbitius spp.			*			
Psilocybe spp.			*			*
Psathyrella spp.			*	*	*	
Conocybe spp.				*		*
Clitocybe spp.				*	*	
Coprinus spp.			*	*	*	*
Total number of genera	**1**	**7**	**18**	**12**	**10**	**9**

The onset of sporulation in the Discomycetes was denoted by the appearance of apothecia of *Cheilymenia* at seven days. At 14 days, species of an additional five genera sporulated for the first time: *Lasiobolus*, *Ascobolus*, *Ascophanus*, *Saccobolus* and *Coprobia*. Perithecia of *Poronia* also appeared at seven days. Unlike the Discomycetes, few Pyrenomycetes sporulated at 14 days. At this time species of two genera (*Sporormia* and *Sordaria*) sporulated for the first time. Species of the remaining two genera then sporulated at 21 days (*Podospora*) and 35 days (*Delitschia*).

Basidiocarps of *Bolbitius* and *Coprinus* appeared at 14 days. The remaining Basidiomycetes sporulated for the first time at 21 days. After this time, the dung began to dry.

The minimum time required by the Zygomycetes, Ascomycetes and Basidiomycetes to sporulate differed. The Ascomycetes displayed greater variation for this parameter than did the Zygomycetes. This was manifested in the difference in the onset of sporulation in the Discomycetes (a single event which occurred at 14 days) relative to that in the Pyrenomycetes (a protracted event which occurred over the entire duration of the experiment). The onset of sporulation in the Basidiomycetes coincided with and persisted beyond that in the Discomycetes.

The change in abundance of genera sporulating on equine dung over time

At 14 days, the highest number of genera sporulated (18) comprising five Phycomycetes, six Discomycetes, three Pyrenomycetes and four Basidiomycetes. After 14 days, the numbers of genera sporulating began to decrease. At 21 days, sporulation in the Phycomycetes ceased and began to decline in the Discomycetes at a rate of about one genus per seven days, a trend that persisted until the end of the experiment. Unlike the Discomycetes, the Pyrenomycetes and Basidiomycetes persisted to sporulate in similar proportion over this period. At the conclusion of the experiment nine genera sporulated.

Table 2. Days to sporulation in several genera occurring on incubated samples of equine dung from Armidale, New South Wales, and on those substrates studied by Harper & Webster (1964), Mitchell (1970), Bell (1975), and Nagy & Harrower (1979)

	Approximate time of onset of sporulation (days)	Authors
Phycomycetes		
Pilobolus spp.	3	Mitchell,[1] Bell, Nagy & Harrower
Pilaira spp.	7	Harper & Webster, Nagy & Harrower
Discomycetes		
Ascobolus spp.	14	Harper & Webster, Mitchell,[2] Bell, Nagy & Harrower
Ascophanus spp.	14	Harper & Webster
Saccobolus spp.	14	Harper & Webster, Mitchell,[3] Nagy & Harrower
Pyrenomycetes		
Sporormia spp.	9-12–22	Harper & Webster, Mitchell,[4] Nagy & Harrower
Sordaria spp.	9-12–22	Harper & Webster, Mitchell,[5] Nagy & Harrower
Podospora spp.	9-12–22	Harper & Webster, Mitchell,[6] Nagy & Harrower
Basidiomycetes		
Coprinus spp.	9-13–20	Harper & Webster, Mitchell,[7] Bell, Nagy & Harrower

DISCUSSION

In this study the pattern of length of time to onset of sporulation in a range of genera colonising equine dung from Armidale, Australia was found to be similar to that displayed by the same genera overseas. The overseas studies were of fungi colonising the dung of rabbit (Harper & Webster 1964), ostrich and angora goat (Mitchell 1970), opossum (Bell 1975) and kangaroo (Nagy & Harrower 1979) (Table 2).

Harper & Webster (1964) attempted to explain the consistency in the onset of sporulation within species of coprophilous fungi by suggesting that each species required a minimum amount of time to produce fruit-bodies. Thus according to Rayner & Todd (1979) citing work done by Harper & Webster, 'the observed succession [of fruit-bodies] could at least partly be explained simply by the increasing amounts of time required by succeeding fungi to fruit'. However, such an explanation is compromised by its inability to account for the substantial variation in the time taken by many coprophilous fungi to cease fruit-body production. In the present study, only species of several genera of Discomycetes totally ceased sporulating within the range of variation for this

[1] Ostrich dung only
[2] Ostrich dung only
[3] Ostrich and angora goat dung
[4] Angora goat dung only
[5] Angora goat dung only
[6] Angora goat dung only
[7] Ostrich and angora goat dung

parameter (28–35 days); similar observations were reported by Harper & Webster (1964), Mitchell (1970), Bell (1975) and Nagy & Harrower (1979). Genera from taxonomic groups other than the Discomycetes ceased fruit-body production at disparate times.

An alternative and perhaps more elegant explanation of the sequence of fruiting of coprophilous fungi has been proposed by Rayner & Todd (1979). They suggest that the apparent succession of fruit-bodies by coprophilous fungi may be attributed to 'the sequential occupation of the same site by thalli (normally mycelia) either of different fungi or of different associations of fungi'.

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