

Study of fungi on dung of different habitats*

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Dung samples of four animals viz., rabbit, rat, fowl and pigeon both in captivity and wild conditions were collected aseptically in sterilized bottles from different places at Gorakhpur (U.P.). These were then transferred to Petri dish moist chambers and incubated for 50 days. The observations were made on the 3rd, 5th, 10th, 15th, 20th, 30th, 40th and 50th day of incubation. The number of fungi on dung of different animals was larger in wild condition than in captivity. Some species were common to both the conditions; a few were recorded from more animals dungs in captivity but from less animals in wild conditions and there were some confined either to the captivity or to the wild condition only. In addition to these, there were still others which were found on one animal dung in captivity and on more animals dungs in wild condition. With a few exceptions in dung samples from captivity, feces of all the animals in both the conditions exhibited a similar pattern of the succession of fungi.

INTRODUCTION

Variation in coprophilous fungal flora under different climatic conditions is now well established (Mitchell 1970; Bednarczyk 1974). Harper and Webster (1964) and Nicholson et al. (1966) have observed rapid rate of dung decomposition in laboratory as compared with field conditions. Study of fungi on dung of the same animal in different habitats may be of greater importance in ascertaining the facts which are significant in ecological studies of such fungi. With this view in mind, an attempt has been made to study the fungi on dung of two mammals and two birds, which were kept in cages and also those who were in free conditions.

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MATERIALS AND METHODS

Dung samples were obtained from four animals (rabbit, rat, fowl, pigeon) captivated in Animal House of Gorakhpur University and those from the same animals in free conditions. The animals in cages were fed normal food keeping in view their natural requirements and those in wild conditions were free to take anything depending on their desire and availability of food. Such dung samples were collected in sterilized bottles with the help of sterilized forceps and spatula. 10 pellets or droppings were then transferred to each Petri dish moist chamber devised by Keyworth (1951). After 24 hours of incubation the samples were examined under the high power lens for any fruiting body. The observations were made on the 3rd, 5th, 10th, 15th, 20th, 30th, 40th and 50th day of incubation. Different dung samples were incubated five times and comparative study of coprophilous fungal flora and trend of their succession was taken into account. Taxonomic diagnosis of the species of *Chaetomium* exhibited the presence of certain variants which were given separate designations to discriminate them from typical species.

RESULTS

A total of 86 fungal species comprising *Phycomycetes* (19), *Ascomycetes* (26), *Basidiomycetes* (5), *Deuteromycetes* (32) and *Mycelia sterilia* (4) were isolated from dung of animals in wild condition. In captivity, however, a total of 56 species isolated comprised 13 *Phycomycetes*, 17 *Ascomycetes*, 3 *Basidiomycetes*, 17 *Deuteromycetes*, 5 *Mycelia sterilia* and 1 *Myxomycetes*. In general, fungi in larger numbers were recorded from the dung of animals in wild condition than in captivity. Among these four animals, the difference in number of fungi in captivity and wild conditions was much greater on pigeon than on other dungs while there was not much difference in fungi in captivity and wild conditions on the dung of rat and fowl. In rabbit, however, there was a slight difference in the number of fungi in captivity and wild conditions. A remarkable increase in the number of species on dung from wild habitat was recorded in *Phycomycetes* and *Ascomycetes* on fowl; *Phycomycetes* and *Deuteromycetes* on pigeon; *Ascomycetes* and *Deuteromycetes* on rat; and *Deuteromycetes* on rabbit dungs (Table 2).

Dung of different animals both in captivity and wild conditions exhibited nearly the same pattern of fungal succession. *Phycomycetes* with a few exceptions viz., *Choanephora cucurbitarum* and *Rhizopus* sp. on pigeon and *Rhopalomyces elegans* on rat which appeared late and persisted for a short time, all the species in wild condition appeared early and persisted for a short time. In captivity, however, most of the species viz., *Absidia spinosa*, *Circinella muscae*, *Helicostylum piriforme*, *Mucor heterosporus*, *M. hiemalis* and *Mucor* sp. I appeared early but remained for a long time. Except one species (*Rhyparobius dubius* on rat),

Table 1

Species recorded on dung of animals in captivity and wild conditions

Species	Captivity	Wild condition
P - <i>Absidia spinosa</i> Lendn.	RRa	RRa
<i>Absidia</i> sp.	-	R
<i>Choanephora cucurbitarum</i> /Berk.et Rav./ Thaxter	-	P
<i>Circinella muscae</i> /Sorok./ Berl.et de Toni	Ra	Ra
<i>Helicostylum piriforme</i> Bain.	R	R
<i>Mucor heterosporus</i> Ling Young	RRa	RRa
<i>M. hiemalis</i> Wehm.	Ra	Ra
<i>Mucor</i> sp. I	Ra	-
<i>Mucor</i> sp. II	-	F
<i>Mucor</i> sp. III	FP	F
<i>Pilaira anomala</i> /Ces./ Schroet.	R	R
<i>Pilobolus crystallinus</i> Tode	R	R
<i>Rhizopus</i> sp.	-	P
<i>Rhopalomyces elegans</i> Corda	-	Ra
<i>Thamnidium elegans</i> Link	R	R
<i>Thamnidium</i> sp.	-	R
A - <i>Chaetomium apiculatum</i> Lodha	-	Ra
<i>C. atrobrunneum</i> Ames, strain I	RP	RP
strain, II	Ra	Ra
strain III	RRa	RRa
<i>C. biapiculatum</i> Lodha	-	Ra
<i>C. erraticum</i> Ames, strain I	-	RRa
strain II	R	R
<i>C. globosum</i> Kunze et Fr., strain I	RRa	RRa
strain II	F	F
strain IV	F	RF
<i>C. gracile</i> Udagawa	Ra	Ra
<i>C. undulatum</i> Bain.	R	R
<i>Chaetomium</i> sp.	F	F
<i>Gelasinospora calospora</i> /Mouton/ Cl.et M. Moreau	F	FP
<i>Kernia nitida</i> /Sacc./ Nieuw.	P	P
<i>Microascus nidicolus</i> Masseur et Salmon	-	F
<i>Fhaeotrichum circinatum</i> Cain	P	P
<i>Rhyparobius dubius</i> Sacc.	-	Ra
<i>Sordaria fimicola</i> /Rob./ Ces. et de Not.	R	-
<i>Thielavia terricola</i> /Gilm. et Abb./Emmons	-	Ra
<i>Triangularia obliqua</i> Cain	-	F

cont. Table 1

B - <i>Coprinus hepthemerus</i> M.Lge et Smith	RRa	-
<i>Coprinus</i> sp.	F	FP
<i>Panaeolus subbalteatus</i> /Berk.et Br./ Sacc.	-	RF
<i>Stropharia merdaria</i> /Fr./ QuéL.	-	R
D - <i>Acladium niveus</i> /Lév./ Sacc.	-	P
<i>Acremoniella atra</i> /Corda/ Sacc.	-	R
<i>Alternaria alternata</i> /Fr./ Keissler	-	P
<i>Alternaria</i> sp.	-	FP
<i>Aspergillus flavus</i> Link	RaFP	RaFP
<i>A. ustus</i> /Bain./ Thom et Church	Ra	RaF
<i>A. versicolor</i> /Vuill./ Tiraboschi	-	FP
<i>Aspergillus</i> sp.	R	R
<i>Cephalophora irregularis</i> Thaxter	FP	FP
<i>Fusarium sporotrichoides</i> Link	RFP	RFP
<i>Graphium</i> sp.	-	R
<i>Humicola</i> sp.	-	Ra
<i>Hymenula cerealis</i> /Fau.et Lam./ Wollen	-	Ra
<i>Macrophoma</i> sp.	-	R
<i>Memnoniella echinata</i> /Riv./ Galloway	RRa	RRa
<i>Monilia candida</i> Bon.	-	P
<i>Myrothecium verrucaria</i> /Alb.et Schw./ Ditm.	Ra	Ra
<i>Paecilomyces</i> sp.	-	Ra
<i>Penicillium nigricans</i> /Bain./ Thom	Ra	Ra
<i>Scopulariopsis brevicaulis</i> /Sacc./ Bain.	-	P
<i>Stachybotrys atra</i> Corda	FP	P
<i>Stysanus medius</i> Sacc.	P	P
<i>Trichoderma viride</i> Pers.	-	Ra
MS - Black sterile mycelium	F	F
White sterile mycelium	RRaFP	FP
Yellow sterile mycelium	-	Ra
MX - <i>Dictyostelium mucoroides</i> Bref.	R	-

R - Rabbit; Ra - Rat; F - Fowl; P - Pigeon; P - Phycomycetes;
 A - Ascomycetes; B - Basidiomycetes; D - Deuteromycetes;
 MS - Mycelia sterilia; MX - Myxomycetes

Table 2
Number of species on dung of rabbit, rat, fowl and pigeon
in captivity and wild conditions

Animal dung	Captivity							Wild condition						
	P	A	B	D	MS	MX	Total	P	A	B	D	MS	MX	Total
Rabbit	6	6	1	3	1	1	18	8	7	2	6	-	-	23
Rat	5	4	1	5	1	-	16	5	9	-	9	1	-	24
Fowl	1	4	1	4	2	-	12	3	6	2	5	2	-	18
Pigeon	1	3	-	5	1	-	10	3	4	1	12	1	-	21
Total	13	17	3	17	5	1	56	19	26	5	32	4	-	86

P - Phycomycetes; A - Ascomycetes; B - Basidiomycetes;
D - Deuteromycetes; MS - Mycelia sterilia; MX - Myxomycetes

appearing late and persisting for a short time, all the *Ascomycetes* appeared late and persisted for a long time in both the conditions. *Basidiomycetes* in both the conditions appeared late and persisted for a short time. Members of *Deuteromycetes* showed a wide range in their appearance and persistence and came under three among the four categories (Table 3). Some of them viz., *Aspergillus flavus*, *Cephalophora irregularis* (on pigeon) and *Fusarium sporotrichoides* (on fowl and pigeon) appeared early and others viz., *Memnoniella echinata*, *Myrothecium verrucaria*, *Penicillium nigricans* and *Stachybotrys atra* late but all of them persisted for a long time in both the conditions. There were others viz., *Cephalophora irregularis* (on fowl), *Aspergillus* sp., *A. ustus*, *Fusarium sporotrichoides* (on rabbit) and *Stysanus medius* to appear late persisting for a long time in captivity. Among those species, *Fusarium sporotrichoides*, *Aspergillus* sp., *A. ustus*, *Cephalophora irregularis* and *Stysanus medius* late but persisted for a short time and long time respectively in wild condition. Sterile mycelia appeared early as well as late but persisted for a long time. *Dictyostelium mucoroides* on rabbit dung in captivity only, appeared ear and persisted for a long time.

DISCUSSION

Species in greater number have been recorded on dung of animals in wild condition than in captivity (Table 2). It seems apparent that the feces from wild condition were not so fresh as collected from captivity and they could have eventually incorporated into the soil particles with greater chance of becoming colonised by additional species of coprophilous fungi. Such fungi may be present in the soil, arrive as airborne inculum, or be transported by arthropod vactors.

Table 3
Appearance and persistence of species on dung of animals
in captivity and wild conditions

Species	Categories of species	
	captivity	wild condition
P - <i>Absidia spinosa</i>	R, Ra:2	R:1
<i>Absidia</i> sp.	R : -	R:1
<i>Circinella muscae</i>	Ra:2	Ra:1
<i>Choanephora cucurbitarum</i>	P: -	P:2
<i>Helicostylum piriforme</i>	R:2	R:1
<i>Mucor heterosporus</i>	R, Ra:2; P:-	R, Ra:1; P:1
<i>Mucor hiemalis</i>	Ra: 2	Ra:1
<i>Mucor</i> sp. I	Ra:2; F:-	Ra:-; P:1
<i>Mucor</i> sp. II	F:-	F:1
<i>Mucor</i> sp. III	F:1; P:1	F:1; P:-
<i>Pilaira anomala</i>	R:1	R:1
<i>Pilobolus crystallinus</i>	R:1	R:1
<i>Rhizopus</i> sp.	P:-	P:3
<i>Rhopalomyces elegans</i>	Ra:-	Ra:3
<i>Thamnidium elegans</i>	R:1	R:1
<i>Thamnidium</i> sp.	R:-	R:1
A - <i>Chaetomium apiculatum</i>	Ra:-	Ra:4
<i>Chaetomium atrobrunneum</i> , I, II, III	R, P, Ra:4	R, P, Ra:4
<i>Chaetomium biapiculatum</i>	Ra:-	Ra:4
<i>C. erraticum</i> , I, II,	R, Ra:-; R:4	R, Ra:4
<i>C. globosum</i> , I, II, IV	R, Ra, F:4; R:-	R, Ra, F:4
<i>C. gracile</i>	Ra:4	Ra:4
<i>C. undulatum</i>	R:4	R:4
<i>Chaetomium</i> sp.	F:4	F:4
<i>Gelasinospora caldspora</i>	F:4; P:-	F, P:4
<i>Kernia nitida</i>	P:4	P:4
<i>Microascus nidicolus</i>	F:-	F:4
<i>Phaeotrichum circinatum</i>	P:4	P:4
<i>Rhyparobus dubius</i>	Ra:-	Ra:3
<i>Sordaria fimicola</i>	R:4	Ra:-
<i>Thielavia terricola</i>	Ra:-	Ra:4
<i>Triangularia obliqua</i>	F:-	F:4
B - <i>Coprinus heptemerus</i>	R, Ra:3	R, Ra:-
<i>Coprinus</i> sp.	F:3; P:-	F, P:3
<i>Panaeolus subdalteatus</i>	R, F:-	R, F:3
<i>Stropharia merdaria</i>	R:-	R:3

D - <i>Acladium niveus</i>	P:-	P:3
<i>Acremoniella atra</i>	R:-	R:3
<i>Alternaria alternata</i>	P:-	P:3
<i>Alternaria</i> sp.	F, P:-	F, P:3
<i>Aspergillus flavus</i>	Ra,F,P:2	Ra,F,P:2
<i>A. ustus</i>	Ra:4; P:-	Ra, P:3
<i>A. versicolor</i>	F, P:-	F, P:3
<i>Aspergillus</i> sp.	R:4	R:2
<i>Cephalophora irregularis</i>	F, P:2	F:3; P:2
<i>Fusarium sporotrichoides</i>	R:4; F,P:2	R,F,P:2
<i>Graphium</i> sp.	R:-	R:4
<i>Humicola</i> sp.	Ra:-	Ra:3
<i>Hymenula cerealis</i>	Ra:-	Ra:3
<i>Macrophoma</i> sp.	R:-	R:4
<i>Memnoniella echinata</i>	R,Ra :4	R,Ra:4
<i>Monilia candida</i>	P:-	P:2
<i>Paecilomyces</i> sp.	Ra:4	Ra:4
<i>Myrothecium verrucaria</i>	Ra:-	Ra:4
<i>Penicillium nigricans</i>	Ra:4	Ra:4
<i>Scopulariopsis brevicaulis</i>	P:-	P:3
<i>Stachybotrys atra</i>	F,P:4	F:-; P:4
<i>Stysanus medius</i>	P:4	P:3
<i>Trichoderma viride</i>	Ra:-	Ra:4
MS - Black sterile mycelium	F:4	F:4
White sterile mycelium	F,Ra:4; R,P:2	P:4; R,Ra:-; F:2
Yellow sterile mycelium	Ra:-	Ra:2
MY - <i>Dictyostelium mucoroides</i>	R:2	R:-

1 - Appearing on 3-5th day, persisting for less than 15 days;

2 - Appearing on 3-5th day, persisting for 15-30 days or more;

3 - Appearing on or after the 10th day, persisting for less than 15 days;

4 - Appearing on or after the 10th day and persisting for 15-30 days or more

A n g e l, W i c k l o w (1975) compared the species lists from both freshly dried and partially decomposed cattle feces and showed that several species found on the older feces were not found on the freshly dried feces. This observation also supports the contention that, given length of time that feces persist, there is a greater possibility that they will become inoculated with additional fungal colonists. One would also expect that coprophagous arthropods could spread fungi from one fecal pile to another. The much greater number of species of a particular class of fungi on dung of animals in wild condition may be due to similar reasons.

Species which have been isolated only from the excreta of animals in captivity (*Mucor* sp. I, *Sordaria fimicola*, *Coprinus heptemerus* and *Dictyostelium mucoroides*) or both in captivity and wild conditions (*Absidia spinosa*, *Circinella muscae*, *Helicostylum biriforme*, *Pilaira anomala*, *Pilobolus crystallinus*, *Thamnidium elegans*, *Kernia nitida*, *Phaeotrichum circinatum*, *Cephalophora irregularis*, *Fusarium sporotrichoides*, *Myrothecium verrucaria*, *Penicillium nigricans*, *Stychnus medius*, black sterile mycelium and species of *Mucor*, *Chaetomium* and *Aspergillus*) can be regarded as true colonizers. Fungi which were present in wild condition only (*Absidia* sp., *Choanephora cucurbitarum*, *Mucor* sp. II, *Rhizopus* sp., *Rhopalomyces elegans*, *Thamnidium* sp., *Microascus nidicolus*, *Rhyparobius dubius*, *Thielavia terricola*, *Triangularia obliqua*, *Panaeolus subdalteatus*, *Stropharia merdaria*, *Acladium niveus*, *Acremoniella atra*, *Aspergillus versicolor*, *Graphium* sp., *Humicola* sp. and species of *Chaetomium* and *Alternaria*) may be facultative Saprophytic colonists, whose reproductive bodies may be present in the atmosphere and have more easy access to the substratum. Species which were present on the dung of different animals either of the same or different classes (*Chaetomium globosum* IV, *Gelasinospora calospora*, *Coprinus* sp. and *Aspergillus ustus*) showed their wide range of nutritional adaptability while others were restricted due to their specific nutritional requirements (Table 2).

The pattern of succession of fungi on dung of these four animals both from captivity and wild conditions was the same. *Phycomycetes* were first to appear on incubated dung, followed by *Ascomycetes* and *Basidiomycetes*. The members of *Deuteromycetes* occurred with all the groups of fungi. A few *Mycelia sterilia* appeared early and others late but all persisted for a long time. A myxomycete appearing early also persisted for a long time (Table 3). B u r g e s (1939, 1958) and G a r r e t t (1951) have attributed this pattern of succession of fruit bodies of fungi to the nutritional requirements of different groups of fungi. The presence of species of certain groups for along time on dung samples from captivity may be ascribed to the availability of nutrients required by them.

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