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Successional studied of fungi on mammalian dung*

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Dung samples of nine animals were collected from different places at Gorakhpur (U.P.) and incubated for 50 days. A total of 79 fungal species comprising *Phycomycetes* (22), *Ascomycetes* (23), *Basidiomycetes* (6), *Deuteromycetes* (21), *Mycelia sterilla* (4) and *Myxomycetes* (3) were isolated from the dung these animals. Among different species isolated, some were found in dung of several animals while others were restricted only to the dung of a particular animal dung. During the succession, the fruitbodies of *Phycomycetes* appeared first, closely followed by *Deuteromycetes*, *Ascomycetes* and *Basidiomycetes*. *Mycelia sterilia* and *Myxomycetes*, appeared early as well as late but persisted for a much longer time.

INTRODUCTION

Dung of animals, which is rich in nutrients, provides a very good habitat for the microflora and microfauna inhabiting this substrate. The fungi colonizing dung behave like saprophytes and utilize a wide range of compounds as their food. Celluloses, lignins, keratins and chitins which are ejected out in the form of excreta and constituts a major portion of dung, are decomposed very actively by these fungi. Mammals are important for their bulk ajection of dung in various shapes which is morphologically and biochemically most suited for the growth of fungi. M a h j u (1933), G i n a i (1936), H i n k o v a and I v a n o v a (1965), B e d n a r c z y k (1974), A n g e l and W i c k l o w (1975) and N u s r a t h (1977) isolated the fungi dung of herbivore and observed significant differences in their fungal flora. A correlation in the nature of mycoflora was also noticed in dung of animals which were taxonomically nearer to each other.

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The study of succession of fungi on herbivore dung is quoted as the classic example of fungal succession. Many studied on this substrate were made well before 1900 and in the early years of the century it was familiar to S a l m o n and M a s s e e (1901 - 1902) who observed the pattern of colonization of different groups of fungi on herbivore dung, at intervals. In recent years, such studied have been done by H a r p e r and W e b s t e r (1964), A l e k-s a n d r a (1965), L o d h a (1968), M i t c h e l l (1970) and others on the dung of different herbivorous mammals.

The ami of the present study is the general survey and successional pattern of fungi on dung of nine different mammals of Gorakhpur.

MATERIALS AND METHODS

During the present investigation, dung samples of buffalo, cow and gost were collected from dairy farms; of ass and horse from road sides; of house-mole and rat from residential buildings and those of monkey and rabbit from three hollows and greasslands, respectively. Maximum efforts were made to collect the fresh dung which was handled with sterilized scalpels and kept in sterilized bottles. These were allowed to be exposed for as little time as possible. 10 pellets or pieces were then transferred to each Petri dish moist chamber devised by K e y-w o r t h (1951). This method allowed the filter paper to keep wat for long time and when needed more sterilized water was added from the sides of the Petri dish. After 24 hours of incubation at room temperature the samples were examined under a high power lens for the presence fruiting bodies. The observation were made on the 3rd, 5th, 10th, 15th, 20th, 30th, 40th, and 50th day of incubation. Different dung samples were incubated five times and the average of the observations was taken into the consideration. The bacteria were isolated from these fresh dung samples by well known dilution plate technique commonly used by bacteriologists to count bacterial.

Specific diagnosis of chaetomia revealed the presence of certain variants within a species which were bridged by the intermediate forms rendering it difficult to establish sharp and immutable lines of separation. These forms showing certain but limited differences within a species were given separate designations to discriminate them from the typical species. .

RESULTS

A total of 79 species including *Phycomycetes* (22), *Ascomycetes* (23), *Basidio-mycetes* (6), *Deuteromycetes* (21), *Mycelia sterilia* (4) and *Myxomycetes* (3) were isolated from the dung of different mammals (Table 2). The number of species was highest on rat dung, gradually descessing on rabbit, house-mole, buffalo, cow,

Table 1

Number of fungi on mammalian dungs

Taxons	Total No.	Dung of different animals								
		Ass	Buffalo	Cow	Goat	Horse	House-mole	Monkey	Rabbit	Rat
Phycomycetes	22	3	4	3	5	3	6	3	8	5
Ascomycetes	23	1	3	3	3	2	7	4	7	9
Basidiomycetes	6	1	1	1	2	1	-	-	2	-
Deuteromycetes	21	-	7	4	1	1	4	2	6	9
Mycelia Sterilia	4	-	1	1	2	1	2	2	-	1
Myxomycetes	3	1	-	1	-	1	-	2	-	-
Total	79	6	16	13	13	9	19	13	23	24

Table 3

Number of fungi on mammalian dungs at intervals

Taxons	Days of incubation							
	3	5	10	15	20	30	40	50
Phycomycetes	13	21	20	17	3	-	-	-
Ascomycetes	-	3	16	23	23	20	18	18
Basidiomycetes	-	-	1	6	4	-	-	-
Deuteromycetes	1	7	14	21	17	9	1	1
Mycelia Sterilia	-	2	4	4	4	3	1	-
Myxomycetes	1	1	1	3	3	2	1	-
Total	15	34	56	74	54	34	21	19

Table 5

Bacterial colony counts/g of dry dung of different animals

Dung of animals	Colony counts/g of dry dung /in thousands/
Ass	1450
Buffalo	1650
Cow	2000
Goat	300
Horse	1500
House-mole	380
Monkey	890
Rabbit	370
Rat	330

goat, monkey, horse and ass dung. The number of *Phycomycetes* was highest on rabbit dung, followed by house-mole, rat, goat and buffalo dung. The number of species on the dung of remaining the animals was the same but less than that of buffalo. *Ascomycetes* were highest in number on rat dung, lesser on rabbit and house-mole, and a few on monkey, cow, buffalo, goat, horse and ass dung. The *Basidiomycetes* though rare, were recorded from ass, buffalo, cow, goat, horse and rabbit dung; but were absent on house-mole, monkey and rat dung. The highest number of *Deuteromycetes* were recorded from the dung of rat followed by buffalo and rabbit. In others, their number was comparatively lower and no *Deuteromycetes* was recorded from ass dung. *Mycelia sterilia* could not be recorded from the dung of ass and rabbit, while *Myxomycetes* were noticed from the dungs of ass, cow, horse and monkey.

The restricted *Phycomycetes* species, recorded on the dung of a single animal were *Helicostylum nigricans* (ass), *Pilobolus Kleinii* (buffalo), *Piptocephalis lepidula* (cow), *Syncephalis sphaerica* (goat), *Cunninghamella echinulata* (monkey) and *Mucor hiemalis* (rat); *Helicostylum* sp., *Mucor* sp. I, *Mucor* sp. II on house--mole and *Helicostylum piriforme*, *Pilaira anomala*, *Thamnidium elegans* on rabbit. The *Ascomycetes* recorded on dung of only one animal were *Aspergillus nidulans* (buffalo), *Ascobolus curvuloides* (cow), *Chaetomium caprinum* (goat); *Bombardia* sp., *Chaetomium globosum* III, *Sordaria* sp., *Tripterospora brevicauda-ta* on house-mole; *Chaetomium atrobrunneum* I, *C. globosum* IV, *C. undulatum* on rabbit; and *Chaetomium apiculatum* and *C. biapiculatum* on rat. The *Deuteromyce-tes* restricted in their occurrence were *Monilia candida* (cow), *Stachybotrys atra* (horse), *Arthrobotrys oligospora* (house-mole), *Aspergillus paradoxus* (monkey); *Aspergillus fumigatus*, *Cladosporium* sp., *Scolecobasidium* sp. on buffalo; *Acremo-niella atra*, *Aspergillus* sp., *Graphium* sp., *Macrophoma* sp. on rabbit; and *Humicola* sp., *Hymenula cerealis*, *Myrothecium verrucaria*, *Trichoderma viride* on rat dung. Black sterile mycelium and brown sterile mycelium were restricted to cow and horse dung, respectively. Two *Myxomycetes* viz., *Diderma radiatum* and *Lycogala epidendrum* recorded on monkey dung only also showed restricted occurrence. Besides these species there were certain others recorded on the dung of two animals (Table 1).

As it is clear from the data in Table 3 that *Phycomycetes* appeared on the 3rd day and thrived well until the 15th day. They were then outnumbered by *Ascomycetes* and *Deuteromycetes* and no *Phycomycetes* could be observed after the 20th day. *Ascomycetes* though appearing a little lata (on the 5th day) persisted in good number up to the 50th day. *Basidiomycetes* were fower in number, made their appearance late (10th day) and none could be found from the 30th day onwards. *Deuteromycetes* made their appearance on the 3rd day and increased steadily upto the 15th day. Their number began to decline thereafter till only one species was left on the 40th day. *Mycelia sterilia* showed their appearance on the 5th day, the number reached the peak on the 10th day which was maintained

Table 2

Fungi isolated from mammalian dungs incubated for 50 days

Fungi	Days of incubation							
	3	5	10	15	20	30	40	50
P - Absidia spinosa Lendn.	R	RRa	RRa	RRa	-	-	-	-
Absidia sp.	B	BR	BR	R	-	-	-	-
Circinella muscae /Sorok./ Berl. et de Toni	-	GHOMRa	GHoMRa	GHoMRa	-	-	-	-
Cunninghamella echinulata /Thaxt./ Thaxt.	-	M	M	M	-	-	-	-
Helicostylum nigricans Bain.	-	A	A	A	-	-	-	-
H. piriforme Bain.	R	R	R	-	-	-	-	-
Helicostylum sp.	-	Ho	Ho	Ho	-	-	-	-
Mucor heterosporus Fisch.	RRa	GRRa	GRRa	GRRa	-	-	-	-
M. hiemalis Wehm.	Ra	Ra	Ra	Ra	-	-	-	-
M. mucedo /L./ Brefeld	AH	ABH	ABH	ABH	AH	-	-	-
Mucor sp. I	Ho	Ho	Ho	Ho	-	-	-	-
Mucor sp. II	Ho	Ho	Ho	Ho	-	-	-	-
Pilaira anomala v.Tiegh.	-	R	R	-	-	-	-	-
Pilobolus crystallinus /Tode /v.Tiegh.	CG	CGR	GR	G	G	-	-	-
P. klenii v.Tiegh.	B	B	-	-	-	-	-	-
P. longipes v.Tiegh.	BCGR	BCGR	G	G	G	-	-	-
P. nanus v.Tiegh.	AH	AH	-	-	-	-	-	-
Piptocephalis lepidula Lendner	-	C	C	C	-	-	-	-
Rhopalomyces elegans Corda	-	-	HoMRa	HoMRa	-	-	-	-
Syncephalis sphaerica v.Tiegh.	-	G	G	G	-	-	-	-
Thamnidium elegans Link ex S.F.Gray	-	R	R	R	-	-	-	-

A - Ascobolus curvuloides Cain	-	-	-	C	C	C	-	-
A. viridulus Currey	-	-	-	BM	BM	-	-	-
Bombardia sp.	-	-	-	Ho	Ho	Ho	Ho	Ho
Chaetomium apiculatum Lodha	-	-	Ra	Ra	Ra	Ra	Ra	Ra
C. atrobrunneum Ames I	-	-	-	R	R	R	R	R
C. atrobrunneum II	-	-	-	HoRa	HoRa	HoRa	HoRa	HoRa
C. atrobrunneum III	-	-	RRa	RRa	RRa	RRa	RRa	RRa
C. biapiculatum Lodha	-	-	Ra	Ra	Ra	Ra	Ra	Ra
C. caprinum Bain.	-	-	G	G	G	G	G	G
C. erraticum Ames I	-	-	R	MRRa	MRRa	MRRa	MRRa	MRRa
C. erraticum II	-	-	R	HoR	HoR	HoR	HoR	HoR
C. globosum Kunze et Fr. I	-	-	CGMRRa	CGMRRa	CGMRRa	CGMRRa	CGMRRa	CGMRRa
C. globosum III	-	-	Ho	Ho	Ho	Ho	Ho	Ho
C. globosum IV	-	-	R	R	R	R	R	R
C. gracile Udagawa	-	-	G	GRa	GRa	GRa	GRa	GRa
C. spirale Zopf	-	C	C	BC	BC	BC	BC	BC
C. undulatum Bain	-	-	R	R	R	R	R	R
Rhyparobus dubius Sacc.	-	-	HoMRa	HoMRa	HoM	-	-	-
Sordaria curvula de Bary	-	-	AH	AH	AH	AH	AH	AH
Sordaria sp.	-	-	-	Ho	Ho	Ho	Ho	Ho
Thielavia terricola /Gilm.et Abb./ Emmons	-	H	H	HRa	HRa	HRa	-	-
Tripterospora bravicaudata Cain	-	-	-	Ho	Ho	Ho	Ho	Ho
B - Bolbitius tener Berk.	-	-	-	C	C	-	-	-
Coprinus ephemerus /Bull.ex Fr./ Fr.	-	-	-	B	-	-	-	-
C. heptemerus Fr.	-	-	-	G	-	-	-	-
C. niveus /Pers. ex Fr./ Fr.	-	-	-	AH	AH	-	-	-
Panaeolus subbalteatus Quel.	-	-	R	R	R	-	-	-
Stropharia merdaria Karst.	-	-	-	GR	GR	-	-	-

D - Acremoniella atra /Corda/ Secc.	-	-	-	R	R	-	-	-
Arthrobotrys oligospora Corda	-	-	Ho	Ho	-	-	-	-
Aspergillus flavus Link ex Fries	-	CRa	CRa	CRa	CRa	CRa	-	-
A. fumigatus Fres.	-		B	B	B	B	-	-
A. nidulans /Eid./ Wingate	-	B	B	B	B	-	-	-
A. paradoxus Fennell et Raper	-	-	M	M	M	-	-	-
A. ustus /Bain./ Thom et Church	-	-	Ra	BRa	BRa	-	-	-
Aspergillus sp.	-	R	R	R	R	-	-	-
Cladosporium sp.	-	B	B	B	-	-	-	-
Fusarium sporotrichoides Sherb.	-	BCGoR	BCHoR	BCHoR	BCHoR	-	-	-
Graphium sp.	-	-	R	R	R	R	-	-
Humicola sp.	-	-	Ra	Ra	-	-	-	-
Hymenula cerealis /Fav. et Lam./ Wollen.	-	-	-	Ra	Ra	-	-	-
Macrophoma sp.	-	-	-	R	R	R	-	-
Memnoniella echinata /Riv./ Galloway	-	-	CHoR	CGHoMRRa	CGHoMRRa	CGHoMRR$_a$	CGHo MRRa	CGHo MRRa
Monilia candida Pers.	-	C	C	C	C	-	-	-
Myrothecium verrucaria /Alb.et Schw./ Ditm. ex Fr.	-	-	-	Ra	Ra	Ra	-	-
Paecilomyces sp.	-	-	-	BRa	BRa	BRa	-	-
Penicillium nigricans Bain. ex Thom.	-	-	HoRa	BHoRa	BHoRa	BHoRa	-	-
Scolecobasidium sp.	B	B	B	B	-	-	-	-
Stachybotrys atra Corda	-	-	-	H	H	H	-	-
Trichoderma viride Pers. ex Fr.	-	-	-	Ra	Ra	Ra	-	-
MS - Blacksterile mycelium	-	-	C	C	C	C	-	-
Brown sterile mycelium	-	-	H	H	H	H	H	-
White sterile mycelium	-	GHoMRa	GHoMRa	GHoMRa	GHoMRa	GHoMRa	-	-

Yellow sterile mycelium	-	GHo MRa	GHo MRa	GHo MRa	GHo MRa	GHo MRa	-	-
MX - Dictyostelium mucoroides Bres.	ACH	ACH	ACH	ACH	ACH	ACH	-	-
Diderma radiatum /L./ Morgan	-	-	-	M	M	M	M	-
Lycogala epidendrum /L./ Fr.	-	-	-	M	M	-	-	-

A - Ass; B - Buffalo; C - Cow; G - Goat; H - Horse; Ho- House-mole; M - Monkey; R - Rabbit; Ra - Rat. P - Phycomycetes; As- Ascomycetes; B - Basidiomycetes; D - Deuteromycetes; MS - Mycelia-Sterilia; MX - Myxomycetes

upto the 20th day and declined after wards. Only one sterile from could be recorded on the 40th day which disappeared afterwards. *Myxomycetes* appeared on the 3rd and reached a peak on the 15th day. Their number declined after 30th day while none could be observed on the 50th day.

A critical look on the species of different classes revealed that they varied in the time of their appearance and disappearance. They may be grouped into four categories:

Those, 1 – appearing early and persisting for a short time (appearing on the 3rd to 5th day and persisting for less than 15 days),

2 – appearing early and persisting for a long time (appearing on the 3rd to 5th day and persisting for 15 - 30 days or more),

3 – appearing late and persisting for a short time (appearing on or of after the 10th day and persisting for less than 15 days),

4 – appearing late and persisting for a long time (appearing on or after the 10th day and persisting for 15 - 30 days or more).

Data in Table 4 show that species of different classes behave differently in their appearance and disappearance on the dung of different animals. The *Phycomycetes* were first to fruit on incubated dung. Most of them viz., *Absidia spinosa*, *Absidia* sp., *Circinella muscae*, *Bunninghamella echinulata*, *Helicostylum nigricans*, *H. piriforme*, *Helicostyllum* sp., *Mucor heterosporus*, *M. hiemalis*, *M. mucedo* (on buffalo), *Mucor* sp. I, *Mucor* sp. II, *Pilaira anomala*, *Pilobolus crystallinus* (on cow and rabbit), *P. kleinii*, *P. longipes* (on cow, buffalo and horse), *P. nanus*, *Piptocephalis lepidula*, *Syncephalis sphaerica*, *Thamnidium elegans* and *Thamnidium* sp. appeared early and persisted for a short time. Three species viz., *Mucor mucedo* (on ass and horse), *Pilobolus crystallinus* and *P. longipes* on goat, though they appeared early, persisted for a long time. *Rhopalomyces elegans* was the only phycomycete which appeared late but persisted for a short time. *Ascomycetes*, in general, appeared late and persisted for a long time. Three of them viz., *Aspergillus nidulans*, *Chaetomium spirale* (on cow) and *Thielavia terricola* (on horse) appeared early and persisted for a long time. *Ascobolus viridulus* and *Rhyparobius dubius* appeared late and persisted for a short time while a large number of species fruited late and persisted for a long time. All the *Basidiomycetes* were observed to appear late but persisting for a short time. Among *Deuteromycetes* which appeared early two (*Cladosporium* sp. and *Scolecobasidium* sp.) among them persisted for a short time and remaining others for a long time. *Acremoniella atra*, *Arthrobotrys oligospora*, *Aspergillus paradoxus*, *A. ustus*, *Humicola* sp. and *Hymenula cerealis* appeared late but persisted for a short time. The remaining others (*Graphium* sp., *Macrophoma* sp., *Memnoniella echinata*, *Myrothecium verrucaria*, *Paecilomyces* sp., *Penicillium nigricans*, *Stachybotrys atra* and *Trichoderma viride*) appeared late and persisted for a long time. In *Myxomycetes Dictyostelium mucoroides* appeared early and persisted for a long time, *Diderma radiatum* and *Lycogala epidendrum* appeared

Table 4

Appearance and persistence of species on mammalian dung

for a short time	for a long time	for a short time	for a long time
	PHYCOMYCETES		
Absidia spinosa /RRa/	Mucor mucedo /AH/	Rhopalomyces elegans /HoMRa/	
Absidia sp. /BR/	Pilobolus crystallinus /G/		
Circinella muscae /GHoMRa/	P. longipes /G/		
Cunninghamella echinulata /M/			
Helicostylum nigricans /A/			
H. piriforme /R/			
Helicostylum sp. /Ho/			
Mucor heterosporus /GRRa/			
M. hiemalis /Ra/			
M. mucedo /B/			
Mucor sp. I /Ho/			
Mucor sp. II /Ho/			
Pilaira anomala /R/			
Pilobolus crystallinus /CR/			
P. klenii /B/			
P. longipes /BCH/			
P. nanus /AH/			
Piptocephalis lepidula /C/			
Syncephalis sphaerica /G/			
Thamnidium elegans /R/			
Thamnidium sp. /HoR/			
	ASCOMYCETES		
Aspergillus nidulans /B/	Ascobolus viridulus /BM/	Bombardia sp. /Ho/	
Chaetomium spirale /C/	Rhyparobius dubius /HoMRa/	Ascobolus curvuloides /C/	
Thielavia terricola /R/ .		Chaetomium apiculatum/Ra/	
		C. atrobrunneum I /R/	
		C. atrobrunneum II /HoRA/	
		C. atrobrunneum III /RRa/	

C. biapiculatum /Ra/
C. caprinum /G/
C. erraticum I /MHRa/
C. erraticum II /HoR/
C. globosum I /CGMRRa/
C. globosum III /Ho/
C. globosum IV /R/
C. gracile /GRa/
C. spirale /B/
C. undulatum /R/
Sordaria curvula /AH/
Sordaria sp. /Ho/
Thielavia terricola /Ra/
Tripterospora brevicauda /Ho/

BASIDIOMYCETES

Bolbitius tener /C/
Coprinus ephemerus /B/
C. heptemerus /G/
C. niveus /AH/
Panaeolus subdalteatus /R/
Stropharia merdaria /GR/

DEUTEROMYCETES

Cladosporium sp. /B/
Scolecobasidium sp./B/
Aspergillus flavus /CRa/
A. fumigatus /B/
Aspergillus sp. /R/
Fusarium sporotrichoides /BCHoR/
Monilia candida /C/
Acremoniella atra /R/
Arthobotrys oligospora /Ho/
Aspergillus paradoxus /M/
A. ustus /BRa/
Humicola sp. /Ra/
Hymenula cerealis /Ra/
Graphium sp. /R/
Macrophoma sp. /R/
Memnoniella echinata /CGHoMRRa/
Myrothecium verrucaria /Ra/
Paecilomyces sp. /BRa/
Penicillium rigricans /BHoRa/
Stachybotrys atra /H/
Trichoderma viride /Ra/

MYCELIA STERILIA		
White sterile mycelium /BGHoM/		Black sterile mycelium /C/
Yellow sterile mycelium /GHoRa/		Brown sterile mycelium /H/
MYXOMYCETES		
Dictyostelium mucoroides /ACH/	Lycogala epidendrum /M/	Diderma radiatum /M/

A - Ass, B - Buffalo, C - Cow, G - Goat, H - Horse, Ho - House mole, M - Monkey, R - Rabbit, Ra - Rat

late but the former persisted for a long time and the latter for a short time.

Table 5 shows that dung of cow, buffalo, horse and ass were very rich in bacterial population, althouth the colony counts of bacteria in cow were higher than those of rest of the animals. In case of monkey, the colony counts reduced almost to half. The goat, rabbit, rat and house-mole dungs appeared to be very poor in bacterial population.

DISCUSSION

In the present study, rat and rabbit dung produced the highest number of species followed by those on house-mole, buffalo, cow, goat and monkey while horse and ass dung harboured the lowest number of species (Table 2). This is entirely to be expected since coprophilous fungi have presumably adapted to micro-habitats, associated with fecal droppings (A n g e l and W i c k l o w 1975). Several attempts habe been made to quantity the relationships between individual species of coprophilous fungi and the faeces of various herbivores. M i t c h e l l (1970) recorded the predominance of *Discomycetes* on South African Ostrich feces collected from same locality. L u n d q u i s t (1972) observed that most coprophilous *Ascomycetes* from Sweden are specialized to one or more type of feces. R i c h a r d s o n (1972) examined 137 different collections of ruminant and lagomorph faces and noted the association of certain species with rumainant faeces, and others with lagomorph faces. In present study, the greater number of *Phycomycetes* on rabbit and house-mole dung; of *Ascomycetes* on rat and rabbit; and that of *Deuteromycetes* on rat and buffalo dung may be in accordance with the above observations (Table 2). The greater number of *Phycomycetes* on rabbit and house-mole may be due to the lower number of bacteria present on the dung of these animals. Their comparative lesser number on dung of the rest of the animals may be attributed to the greater number of bacteria which affect the growth and sporulation of these fungi (Tables 2 and 5). The number of *Basidiomycetes* and *Mycelia sterilia* was nearly the same on the dung of different animals though it was much less than *Phycomycetes*, *Ascomycetes* and *Deuteromycetes*. The similarity in their occurrence may be due to taxonomic relation between them. According to A l e x o p o u l o s (1952, pp. 318), many of the *Mycelia sterilia* proved to be *Basidiomycetes* when their perfect stages were discovered. R a p e r (1951) while cultivating simple slime molds, suggested a number of solid media valuable specially in cultivation of *Dictyostelium discoideum* and related species. In the present study, occurrence of *Myxomycetes* on dung of ass, cow, horse and monkey may be due to the conditions favourable for their growth and plasmodia formation.

Some species belonging to all the major groups of fungi were of common occurrence and several others restricted in their occurrence on the dung of

different animals (Table 1). The reason for their common occurrence may be ascribed to the presence of their spores in regular cycle in the alimentry canal of these animals (L o d h a 1974) and their restricted occurrence to the chance ancorporation of spores of these fungi with food or due to contamination of spores through soil or air.

Sequential appearance of fungi was early the same on dung of different animals. During the succession of fungi on incubated dung fruiting bodies of *Phycomycetes* appeared first being closely followed by *Deuteromycetes*, *Ascomycetes* and *Basidiomycetes*. *Mycelia sterilia* and *Myxomycetes*, though lesser in numbers, appeared early and late but both persisted for a much longer time (Table 4). This pattern of succession of fungi agrees with the observations of H a r p e r and W e b s t e r (1964) on pellets of rabbit. B u r g e s (1939 and 1958) and G a r r e t t (1951) have elaborated the concept of ecological groups of fungi based on their substrate relationships. They pointed out an apparent correlation between the decomposition of progressively complex carbon sources and the taxonomic disposition of the species. During the decomposition of manures, composts and plant litters, sugars, starches and proteins are the first to be utilized followed by hemicelluloses; deignis usually disappear in the last phase of decomposition. Early appearance of *Phycomycetes* is due to their rapid spore germination, high growth rate, short time taken in necessary developmental process in fruit body formation and ability to utilize the soluble part of the substrate quickly. The *Mucorales* are said to be an example of so-called sugar-fungi which show a rapid 'flare-up' on substrates rich in soluble nutrients and disappear with the depletion of these substances. The short persistence of these fungi is possibly due to competition between fungi and bacteria for food because bacteria have been found to be more active in decomposition during the first two weeks when *Phycomycetes* are present (C a r t e r 1958 and N i c h o l s o n et al. 1966). The early appearence and long persistence of *Mucor mucedo* (on ass and horse), *Pilobolus crystallinus* and *P. longipes* on goat shows that these species are able to grow even on nutritionally dificient substrates. Late appearance of *Rhopalomyces elegans* may be attributed either to the longer latent period of its spore germination or to the presence of bacteria in large numbers which inhibit their spore germination. Its short persistence, however, may be ascribed to the intence competition among the fungi themselves and also to the depletion of simple carbohydrates required by this species.

Only a few *Ascomycetes* appeared while the *Phycomycetes* were persisting. With the depletion of soluble nutrients the *Phycomycetes* began to disappear gradually giving way to the fruiting bodies of *Ascomycetes* in larger numbers. These fungi are able to utilize hemicelluloses and celluloses (S i u and R e e s e 1953) present in the substrate in greater amounts. The early appearance and long persistence of some of the *Ascomycetes* viz., *Aspergillus nidulans* (buffalo),

Chaetomium spirale (cow) and *Thielavia terricola* (horse) appears to be related to their rapid growth rate and ability to utilize sugars in addition to celluloses (H a w k e r and C h a w d h a r y 1946 and W a l s h and H a r l e y 1962). The late appearance and short persistence of *Ascobolus viridulus* and *Rhyparobius dubius* was corresponded to their slow growth rate and effect of competition with the fruiting of *Coprinus ephemerus* (H a r p e r and W e b s t e r 1964). The late appearance of fruit bodies and their long persistence is evident in most of the *Ascomycetes* like *Ascobolus curvuloides*, *Bombardia* sp., *Thielavia terricola* (rat.), *Tripterospora brevicaudata* and species of *Chaetomium* and *Sordiara*. Their late appearance may be due to long time taken in their fruit body formation (G r i f f i n 1972, pp. 40) and long persistence due to the availability of hemicelluloses and celluloses for a longer time in the substrate.

The fruit bodies of *Basidiomycetes* appeared very late during succession and disappeared after a short duration. Their late appearance may be associated with very slow growth rate of these forms (B u r g e s 1960 and G r i f f i n 1972, pp. 39). They are able to persist for a short duration only as their fruiting bodies are very delicate and decay soon after maturation. The behaviour of most of the *Deuteromycetes* was similar to *Ascomycetes* in their apperance and persistance. Explanations of the behaviour of *Ascomycetes* are also true for *Deuteromycetes*. *Mycelia sterilia* appearing either early or late in succession persisted for a long time. A myxomycete *Dictyostelium mucoroides*, appeared early probably due to the availability of bacterial cells as the source of food (R a p e r 1951). Its presence for a long time suggests its ability to utilize cellulose also. Late appearance of *Diderna radiatum* and *Lycogala epidendrum* may be ascribed to their slow growth rate.

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