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A study of fungi on droppings of certain birds

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Droppings of fowl, owl, parrot, pigeon and sparrow were aseptically collected in sterilized bottles from different places at Gorakhpur; 54 fungi were isolated. The number of fungi was more in the pigeon showing considerable decrease in the fowl and the sparrow. In the parrot and the owl, however, the fungi were egual in number. The number of *Phycomycetes* was almost the same on droppings of all birds, from parrot only one species could be isolated. A larger number of *Ascomyteces* was recorded from fowl, less from pigeon and owl and the least (two each) on sparrow and parrot droppings. The *Basidiomycetes*, represented by two species only, were recorded on owl and pigeon droppings. Pigeon droppings yielded the largest number of *Deuteromycetes*. They were egual in numbers on owl and parrot while on fowl and sparrow their number was comparatively less. *Mycelia sterilia*, though poor in their numbers, were recorded on all the bird droppings excepting owl.

INTRODUCTION

Many fungi are known to occur on bird dung. But these are supposed to get there either by chance eating along with food or through air or water currents. Lodha (1974) considered these fungi next to those observed on mammalian dung called them the fungi of „Second category". He also suggested that the spores of these fungi are not found in the intestine of birds or on their droppings on the regular cycle, as in herbivore mammals. Observations made on the fungi growing on dung of different animals also suggest their greater number on mammalian dung than on bird droppings (Singh 1981). A survey of the literature reveals that the study on succesion of fungi on bird dung has been done so far only by Watling (1963) on the excreta of the hawk.

Since such studies on bird droppings appear guite meagre, it has been proposed to isolate the fungi from the excreta of five different birds of Gorakhpur and study their pattern of seccesion.

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MATERIALS AND METHODS

For the proposed study, the droppings of fowl were collected from the poultry farms; of owl, pigeon and sparrow from the buildings of Gorakhpur University and those of parrot from the houses where these were kept in cages. Care was taken to collect fresh droppings which were kept in sterilized bottles with the help of sterilized scalpes and spatulas: 10 droppings were then transferred to each Petri dish moist chamber devised by Keyworth (1951). This method allowed the filter paper to keep wet for long time. 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 high power lens for fungal fruit bodies. The observations were made on the 3rd, 5th, 10th, 15th, 20th, 30th, 40th, and 50th day of incubation. This procedure was repeated five times and an average of the observations was made. The bacteria were isolated from the fresh dung samples by dilution plate technigues commonly used by bacteriologists for counting bacteriologists for counting bacterial numbers.

Specific diagnosis of *Chaetomia* shows the presence of certain variants within the species which were given separate designations to distinquish them from the typical species.

RESULTS

A total of 54 fungi comprising 10 *Phycomycetes, 16 Ascomycetes, 2 Basidiomycetes, 23 Deuteromycetes* and 3 *Mycelia sterilia* were isolated from bird droppings (Table 1). Pigeon droppings harboured the highest number of fungi followed by fowl, sparrow, owl and parrot. The number of *Phycomycetes* isolated was nearly the same from the droppings of sparrow, fowl, owl and pigeon but that of parrot produced only one species. *Ascomycetes* were highest in number on fowl, less on pigeon and sparrow and only two each on owl and parrot droppings. *Basidiomycetes* were recorded only from fowl and pigeon droppings. The number of *Deuteromycetes* was higher than any other group of fungi. These were more numerous on pigeon and comparatively less on other bird droppings. *Mycelia sterilia*, though in smaller number, were present on fowl, pigeon, parrot and sparrow but were absent from owl droppings.

Of different species isolated, *Mucor* sp. I, *Alternaria* sp., *Aspergillus flavus, A. versicolor, Cephaliophora irregularis, Fusarium sporotrichoides* and white sterile mycelium were of common occurrence, recorded on three or more of these birds. The species occurring on droppings of a single bird only were regarded as restricted species. (Table 2).

It is evident (Table 3) that *Zygomycetes* appeared on the 3rd day and thrived well upto 15th day. These were then outnumbered by *Ascomycetes* and *Deuteromycetes* and no *Zygomycetes* could be observed after the 20th day. *Ascomycetes* appeared late (10th day) , maintained their number upto the 50th day. Only two

Table 1

Number of fungi on bird droppings

Fungal classes	Total No.	Droppings of different birds				
		F	O	Pa	P	S
Zygomycetes	10	3	3	1	3	4
Ascomycetes	16	6	2	2	4	4
Basidiomycetes	2	2	-	-	1	-
Deuteromycetes	23	5	8	8	12	6
Mycelia sterilia	3	2	-	2	1	2
Total	54	18	13	13	21	16

F - Fowl; O - Owl; Pa - Parrot; P - Pigeon; S - Sparrow

Basidiomycetes made their appearance on the 10th day (late) and none could be found on the 30th day onwards. *Deuteromycetes* made their apperance on the 3rd day increased steadily up to the 15th day after which their number began to decline till only one species was left on the 40th day. *Mycelia sterilia* appeared on the 5th day, their number reached the peak on the 15th day which was maintained upto the 30th day. They number began to decline thereafter and none could be found on the 50th day.

A closer lock on the species of different classes revealed that they varied in time of their appearance and disappearance. They may be grouped into four categories. Those,

– appearing early and persisting for a short time (persisting for less than 15 days),

– appearing early and persisting for a long time (persisting for 15-30 days),

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

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

It is clear (Table 4) that most of the *Phycomycetes* appeared early and persisted for a short time while three others viz. *Choanephora cucurbitarum, Mucor* sp. II (on sparrow) and *Rhizopus* sp. appeared late but persisted for a short time. The *Ascomycetes* and *Basidiomycetes* appeared late but former persisted for a long time and the latter for a short time. The *Ascomycetes* and *Basidiomycetes* appeared late but former persisted for a long time and the latter for a short time. Among *Deuteromycetes,* one fungus (*Aspergillus sydowi)* appeared early and persisted for a short time, *Aspergillus flavus, A. versicolor, Cephallophora irregularis, Fusarium sporotrichoides* and *Monilia candida* appeared early but persisted for a long time;

Table 2

Fungi isolated from bird droppings incubated for 50 days

Fungi	Days of incubation							
	3	5	10	15	20	30	40	50
ZYGOMYCETES								
Choanephora cucurbitarum /Berk. et Rav./ Thaxter	-	-	PS	PS	P	-	-	-
Mortierella sp.	-	O	O	-	-	-	-	-
Mucor heterosporus Ling Young	P	P	P	-	-	-	-	-
M. subtilissimus Oud.	-	O	O	O	-	-	-	-
Mucor sp. I	PaS	FPaS	FPaS	FPaS	-	-	-	-
Mucor sp. II	-	F	FS	FS	-	-	-	-
Mucor sp. III	-	F	F	F	-	-	-	-
Piptocephalis lepidula /Marchal/ Benj.	-	O	O	O	-	-	-	-
Rhizopus oryzae Went et Prinsen	S	S	S	-	-	-	-	-
Rhizopus sp.	-	-	P	P	-	-	-	-
ASCOMYCETES								
Chaetomium atrobrunneum Ames	-	-	P	P	P	P	P	P
C. bostrychodes Zopf	-	-	S	S	S	S	S	S
C. brasiliense Batista et Pont.	-	-	-	S	S	S	S	S
C. erraticum Ames II	-	-	S	S	S	S	S	S
C. globosum Kunze et Fr. I	-	-	O	O	O	O	O	O
C. globosum II	-	-	-	P	P	P	P	P
C. globosum III	-	-	S	S	S	S	S	S
C. globosum IV	-	-	P	P	P	P	P	P
C. undulatum Bain.	-	-	-	O	O	O	O	O
Chaetomium sp.	-	-	-	P	P	P	P	P
Gelasinospora calospora /Mouton/ Moreau et Moreau	-	-	-	FP	FP	FP	FP	FP
Kernia nitida /Sacc./ Nieuwl.	-	-	-	P	P	P	P	P
Microascus nidicolus Massee et Salmon	-	-	-	P	P	P	P	P
Phaeotrichum circinatum Cain	-	-	-	PaP	PaP	PaP	PaP	PaP
Sordaria sp.	-	-	-	Pa	Pa	Pa	Pa	Pa
Triangularia obliqua Cain	-	-	-	P	P	P	P	P
BASIDIOMYCETES								
Coprinus sp.	-	-	-	FP	FP	-	-	-
Panaeolus subdalteatus Quél	-	-	P	P	P	-	-	-
DEUTEROMYCETES								
Acladium niveus /Lev./ Sacc.	-	-	P	P	P	-	-	-
Alternaria alternata /Fr./Keissler	-	-	OP	OP	OP	-	-	-
Alternaria sp.	-	-	-	FoP	FoP	-	-	-
Aspergillus flavus Link ex Pries	Pa	POPaP	POPaP	POPaP	POPaP	POPaP	-	-
A. niger v. Tieghem	-	-	Pa	Pa	-	-	-	-
A. oryzae /Ahlb./ Conn	-	-	-	S	S	-	-	-
A. sydowi /Bain.et Sart./ Thom et Church	S	S	S	S	-	-	-	-
A. ustus /Bain./ Thom et Church	-	-	P	PaP	PaP	-	-	-
A. versicolor /Vuill./ Tiraboschi	S	S	POPS	POPS	POPS	-	-	-
Aspergillus sp.	-	-	S	S	S	-	-	-
Cephalophora irregularis Thaxter	P	P	P	POPS	POPS	-	-	-
Coremium sp.	-	-	-	Pa	Pa	-	-	-
Curvularia sp.	-	-	-	Pa	Pa	-	-	-
Dactylaria sp.	-	-	Pa	Pa	-	-	-	-
Fusarium roseum Link	-	-	O	O	O	-	-	-
F. sporotrichoides Sherb.	-	FP	FPaP	FPaP	FPaP	-	-	-
Graphium sp.	-	-	S	S	-	-	-	-
Memnoniella echinata /Riv./ Galloway	-	-	O	O	O	O	O	O
Monilia candida Bon.	-	P	P	P	P	-	-	-
Scopulariopsis bravicaulis /Sacc./ Bainier	-	-	P	P	P	-	-	-
Stachybotrys atra Corda	-	-	P	P	P	P	-	-
Stysanus medius Sacc.	-	-	P	P	P	-	-	-
Trichoderma viride Pers. ex Fr.	-	-	OPa	OPa	OPa	OPa	-	-
MYCELIA STERILIA								
Black sterile mycelium	-	-	F	FPa	FPa	FPa	FPa	-
Brown sterile mycelium	-	-	-	S	S	S	S	-
White sterile mycelium	PS	FPaPS	FPaPS	FPaPS	FPaPS	FPaPS	-	-

P - Powl; O - OWl; Pa - Parrot; P - Pigeon; S - Sparrow

Table 3

Number of fungi on bird droppings at intervals

Fungal classes	Days of incubation							
	3	5	10	15	20	30	40	50
Zygomycetes	3	8	10	8	1	-	-	-
Ascomycetes	-	-	5	16	16	16	16	16
Basidiomycetes	-	-	1	2	2	-	-	-
Deuteromycetes	4	6	19	23	19	4	1	1
Mycelia sterilia	-	1	2	3	3	3	2	-
Total	7	15	37	52	41	23	19	17

the rest appeared late but persisted for a short time, and *Memnoniella echinata, Stachybotrys atra* and *Trichoderma viride* appeared late but persisted for a long time. *Mycelia sterilia* comprised white sterile mycelium which appeared early, and black sterile mycelium, brown sterile mycelium and white sterile mycelium which appeared late but all persisted for a long time.

In droppings of different birds, the maximum bacterial colony counts were obtained in pigeon (2850000) and fowl (2600000) followed by parrot owl and sparrow respectively (Table 5).

DISCUSSION

During the investigation, the greatest number of fungi were recorded on pigeon (20) and comparatively fewer on fowl (18), sparrow (16), parrot (13) and owl (13) droppings due to the selective nature of these fungi for the substrates (Table 1). The distributional pattern of these fungi may also be determined by their physiological responses to the environment into which these are introduced. The overall low number of *Zygomycetes* on droppings of birds is ascribed to high bacterial contents (Table 5) and the semi-solid state of the excreta which is favourable for bacterial multiplication. With some exceptions, the relative number of *Ascomycetes* and *Deuteromycetes* was similar (Table 1) on the droppings of all the birds which may be due to similar nutritional behaviour of the two classes (Garret 1963: 66). Taxonomically also, the majority of *Deuteromycetes* are imperfect stages *Ascomycetes*. The number of *Basidiomycetes* and *mycelia sterilia* was nearly the same on the droppings of different birds. The similarity in their occurrence may be due to the taxonomic relation between them. Accorrding to Alexopoulos (1952: 318) many of the *mycelia sterilia* proved to be *Basidiomycetes* when their perfect stages were discovered. Of all the species isolated, only *Mucor* sp. I, *Alternaria* sp., *Aspergillus flavus, A. versicolor, Cephalophora irregularis, Fusarium sporotrichoides* and white sterile mycelium were of common occurence and the majority of

Table 4

Appearance and persistence of species on bird droppings

Appearing early, persisting for a short time	Appearing early, persisting for a long time	Appearing late, persisting for a short time	Appearing late, persisting for long time
ZYGOMYCETES	ZYGOMYCETES	ZYGOMYCETES	ZYGOMYCETES
Mortierella sp./O/	X	Choanephora cucurbitarum /PS/	X
Mucor heterosporus /P/		Mucor sp.II /S/	
M.subtilissimus/O/		Rhizopus sp./P/	
Mucor sp.I /FPaS/			
Mucor sp,II and sp.III /F/			
Piptocephalis lepidula /O/			
Rhizopus oryzae/S/			
ASCOMYCETES	ASCOMYCETES	ASCOMYCETES	ASCOMYCETES
X	X	X	Chaetomium atrobrunneum I /P/
			C.bostrychodes /S/
			C.brasiliense /S/
			C.erraticum II /S/
			C.globosum I /O/
			C.globosum II and IV /F/
			C.globosum III/S/
			C.undulatum /O/
			Chaetomium sp./F/
			Gelasinospora calospora /FP/
			Kernia nitida /P/
			Microascus nidicolus /F/
			Chaeotrichum circinatum /PaP/
			Sordaria sp./Pa/
			Triangularia obliqua /F/
BASIDIOMYCETES	BASIDIOMYCETES	BASIDIOMYCETES	BASIDIOMYCETES
X	X	Coprinus sp./FP/	X
		Panaeolus subdalteatus /F/	

DEUTEROMYCETES	DEUTEROMYCETES	DEUTEROMYCETES	DEUTEROMYCETES
Aspergillus sydovi /S/	Aspergillus flavus /FOPaP/	Acladium niveus /P/	Memnoniella chinata /O/
	A.versicolor /S/	Alternaria alternata /OP/	Stachybotrys atra /P/
	Cephaliophora irregularis /P/	Alternaria sp. /FOP/	Trichoderma viride /OPa/
	Fusarium sporetrichoides /FP/	Aspergillus niger /Pa/	
	Monilia candida /S/	A. oryzae /S/	
		A. ustus /PaP/	
		A. versicolor /FOP/	
		Aspergillus sp. /S/	
		Cephaliophora irregularis /FOS/	
		Coremium sp. /Pa/	
		Curvularia sp. /Pa/	
		Dactylaria sp. /Pa/	
		Fusarium roseum /O/	
		F.sporotrichoides /Pa/	
		Graphium sp. /S/	
		Scopulariopsis brevicaulis /P/	
		Stysanus medius	
MYCELIA STERILIA	MYCELIA STERILIA	MYCELIA STERILIA	MYCELIA STERILIA
X	Whitesterile mycelium /FS/	X	Blac sterile mycelium /FPa/
			Brown sterile mycelium /S/
			White sterile mycelium /PaP/

F - Fowl; O - Owl; Pa - Parrot; P - Pigeon; S - Sparrow

them exhibited their restricted occurrence of the droppings od different birds (Table 2). It has been suggested that the spores of these fungi are not found in the intestine of birds or on their droppings in the regular cycle as observed in herbivorous mammals (L o d h a 1974). The common occurrence of these fungi may ascribed to their viability and recurrence in the alimentary canal of these birds and their restricted occurrene to chance encorporation of their spores with food or through air or water currents.

TABLE 5

Bacterial colony counts/g of dry droppings of different birds

Droppings of birds	Colony counts/g of dry droppings /in thousands/
Fowl	2600
Owl	2050
Parrot	2400
Pigeon	2850
Sparrow	1900

During the succession of fungi, fruiting bodies of *Zygomycetes* appeared first, closely followed by *Deteromycetes, Ascomycetes* and *Basidiomycetes. Mycelia sterilia* appeared early as well as late and parsisted for a much longer time (Table 4). This pattern of succession of fungi agrees with observations of Harper and Webster (1964) on rabbit pellets and Wetling (1963) on hawk pellets. Burges (1939, 1958) and Garrett (1951) proposed what Webster (1970) has called the Nutritional Hypothesis which attributes the succession of fruit bodies on dung to the nutritional requirements of these groups of fungi. It has been pointed out that during the decomposition of manuares, composts and plant litters, sugars, starches and proteins are first to be utilized followed by hemicelluloses and celluloses. Lignings ususaly disappear towards the last phase of decomposition. Early apperance of *Zygomycetes* is due to their rapid spore germination, high growth rate, short time taken in necessary developmental processes in fruit body formation and ability to utilize the soluble part of the substrate quickly. *Zygomycetes* are often referred to as sugar-fungi which grow comparatively faster on the substrate rich in soluble nutrients and dissppear when these substances are depleted. The short persistence of these forms may be due to competition between fungi and bacteria for food because these have been found to be more active in decomposition during the first two weeks when *Phycomycetes* are present. Carter (1958) and Nicholson et al. (1966) have attributed the short persistence of these fungi to inhibition of their growth by bacteria. Late appearance of *Choanephora cucurbitarum, Mucor* sp. II and *Rhizopus* sp. may be attributed either to the longer latent period of spore germination of these forms or to the presence of bacteria in large numbers which inhibit their spore germination. The short persistence of these forms, however, may be ascribed to the intense competition among the fungi themselves and also to the depletion of simple carbohydrates required by these fungi. Late apperance and long persistence of fruit bodies is evident in all the *Ascomycetes* (Table 4). Their late apperance may be due to slow mycelial growth rate and long time taken in their fruit body formation (Griffin 1972: 40). Their long persistence is due to the

availability of hemicelluloses and celluloses for a longer time in the substrate. The *Basidiomycetes* appeared very late during succesion and diaappeared only after a short duration. Their late appearance may be associated with very slow growth rate of these forms (Burges 1960; Griffin 1972). The reason for their short persistence may be the decomposition of their fructification soon after the maturation. The behaviour of most of the *Deuteromycetes* was similar to *Ascomycetes* in their apperance and persistence but the late appearance and short persistence of most the species is due to similar seasons which resulted in late appearance and short persistence of some of the *Zygomycetes*. *Mycelia sterilia* which appeared either early or late in succession persisted for a long time. Their behaviour was supposed to be similar to *Basidiomycetes* in exploitation of the substratum.

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