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Fungal Population and Community Development on Leaf Litter of *Casuarina Equisetifolia* L. in Coastal Sand Dunes of Orissa

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ABSTRACT A total of 99 species belonging to 50 genera of fungi were isolated from Casuarina leaf litter during 1988-90. Fungal population was maximum in humus litter and minimum in senescent leaves. Bacteria shows the same trend as fungi. Certain Primary saprophytes which dominated the senescent leaves and fresh litter disappeared in humus litter. *Trichoderma viride* which was not a prominent member in senescent leaf and fresh litter became the dominant one and occupied the first rank in partially decomposed and humus litter. Secondary saprophytes particularly members of the Mastigomycotina appeared in association with *T. viride, Aspergillus niger* and *A. awamori* to utilise the cellulose decomposed product.

INTRODUCTION

Colonization and decomposition of litter in soil is carried out by a wide range of micro-organisms with fungi thought to be dominant in early stage. A number of records on the pattern of colonization and succession of fungi either on leaf surfaces (Lindsay and Pugh, 1971; Dickinson, 1976; Thomas and Ghattock, 1986) or on decomposing litter (Hudson and Webster, 1958; Hering 1965; Hugs and Hudson, 1966; Hudson, 1968; Chapal and Boddy, 1988) is there but only few records include the study of senescent and the decomposing litter (Visser and Parkinson, 1975; Misra and Dickinson, 1984). Although information is available on dynamics of fungal colonization of litter after reaching the ground, it is now evident that not all fungi found within decomposing litter originate after fall. Several microfungi are known to occur on senescent and attached dead leaves designated as primary saprophytes (Hudson, 1968) which form the first stage of the succession of litter. They develop rapidly soon after the litter falls on the ground floor. After that clearly one finds a complex range of colonization strategies that run in parallel with the properties of litter during decomposition. Such studies in monoculture *Casuarina* plantation particularly in sandy coastal belts are lacking. This paper reports the fate of the primary saprophytes and lacking. This paper reports the fate of the primary saprophytes and the dynamics of fungal colonization and population of *Casuarina equisetifolia* L. leaf [1] litter in coastal belt of south Orissa.

MATERIAL AND METHODS

The site of the study was Ganjam district of Orissa, 19°.15'N Latitude and 84°.50' E Longitude having 60 km of sea coast along the Bay of Bengal at a height of 6-8 m above MSL. The climate of the region is monsoonic with costal characteristics. Four samples *i.e.* senescent yellow leaf needles (SL), freshly fall needle (FL), partially decomposed litter (PDL) and humus litter (HL) were collected monthly in polythene bags, which were temporarily stored in an ice chest for isolation of microbes. The fungi were isolated by serial washing and direct plate method using patato dextrose Agar medium. 10^3 dilution was used for Fungi and 10^4 for bacteria. Bacterial plate count was made after 48 hr and Fungi were studied after 3-7 days of incubation. Moisture content was recorded by oven drying method.

RESULTS

The maximum number of fungal propagules were recorded from HL followed by PDL, FL and

1. Leaf here referes to the green needles which morphologically represent a modified stem with reduced leaves in whorls at the nodes.

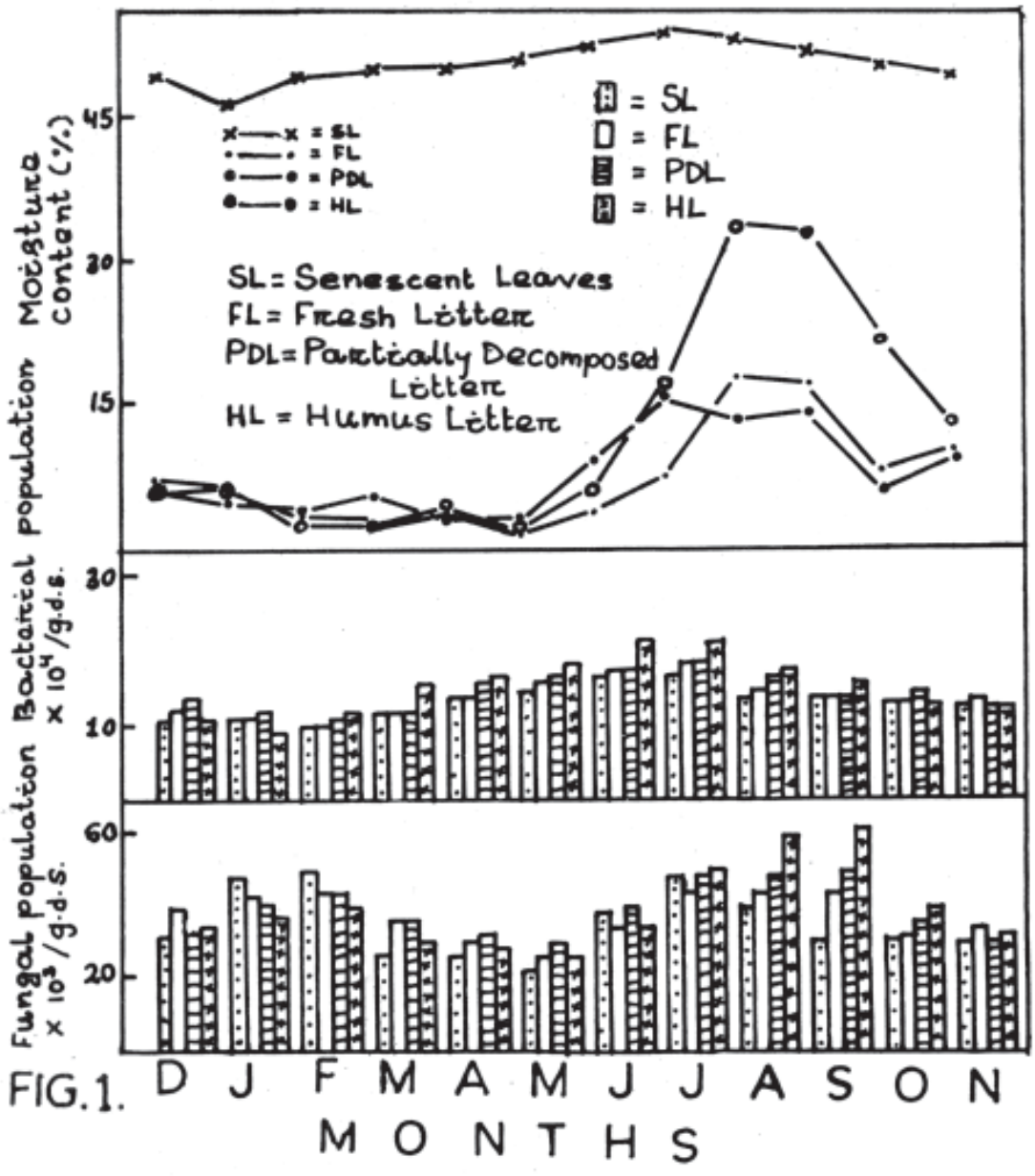

FIG. 1.

Fig. 1. Monthly variation in fungal and bacterial population in relation to moisture at various stages of litter decomposition

SL (Fig. 1). Bacterial population shows the same trend as fungi. Fungal population attained its maximum in July in SL, FL and September in PDL, HL and minimum in May in all the samples (Fig. 1). Of 2865 colonies the SL contributed 601 colonies 43 genera and 81 species, FL 628 colonies, 42 genera and 82 species, PDL 786 colonies, 36 genera, 69 species and HL 850 colonies, 34 genera and 60 species.

Deuteromycotina constituted about 73 - 84% followed by Zygomycotina and Ascomycotina in all the samples (Table 1). Fungal community structure changed depending upon the litter types. In senescent leaf, among others, *Pestalotia* species, *Cytosporina* species, *Aspergillus awamori*, *A. Fumigatus* and *Curvularia lunata* were the five dominant fungi in order of their rank (Table 2). In fresh litter *Cytosporina* species was the dominant one followed by *Pestalotia* species, *Aspergillus awamori*, *A.niger* and *Cladosporium cladosporioides* (Table 2). In PDL and HL, the order of fungi is totally different from that of SL and FL. In PDL, *Tricoderma* species was the dominant followed by *A.awamori*, *P. verruculosum*, *A.niger* and *Cunninghamella* species and in HL, *Tricoderma* was the dominant followed by *P.verruculosum*, *Absidia glauca*, *A.awamori* and *A.niger* (Table 2).

The precise period of the disappearance of *Cytosporina* species and *Pestalotia* species was not acertained, but these seem to disappear within 2-3 months of litter presence on the ground. *T.viride* gradually invaded as the litter aged on the ground proceeding towards decomposition and it represented highest in PDL and HL. Other fungi associated with *T.viride* were *Cunninghamella* species, *Absidia* species, *Rhizopus* species and Mucor species which contributed about 29% to the total in HL. These members were insignificant in other samples.

DISCUSSION

A distinctive pattern in fungal community structure was observed in all the four samples during the study period. Considering the dominant fungi, it is clear that composition of fungal species in PDL and HL greatly differed from that of the SL and FL. Certain dominant saprophytic members like *Absidia glauca, Cunninghamella*

Table 1: Special group distribution of fungi in the leaf and litter samples (Average of 2 years)

Fungal Group	Senescent Leaves				Fresh Litter				Partially Decomposed Litter				Humus Litter			
	No. of genera	% of total	No. of species	% of total	No. of genera	% of total	No. of species	% of total	No. of genera	% of total	No. of species	% of total	No. of genera	% of total	No. of species	% of total
Zygomycetes	05	11.6	06	7.4	05	11.9	05	6.1	05	13.9	07	10.1	05	14.7	07	11.7
Ascomycetes	02	4.7	02	2.5	04	9.5	04	4.9	02	5.5	02	2.9	04	11.8	04	6.6
Deuteromycetes	36	83.7	73	90.1	33	78.6	73	89.0	29	80.6	60	87.0	25	73.5	49	81.7
Moniliales	25	69.4	62	84.9	24	72.7	64	87.7	21	72.4	52	86.7	20	80.0	44	89.8
Sphaeropsidales	07	19.4	07	9.6	05	15.2	05	6.8	04	13.8	04	6.7	02	8.0	02	4.1
Melanconiales	01	2.8	01	1.4	01	3.0	01	1.4	01	3.4	01	1.6	01	4.0	01	2.0
Mycellia sterilia	03	8.3	03	4.1	03	9.1	03	4.1	03	10.3	03	5.0	02	8.0	02	4.1
Total	43	100	81	100	42	100	82	100	36	100	69	100	34	100	60	100

verticillata, Rhizopus nigricans, Mucor species and *Syncephalastrum* sp., which are absent or poorly isolated from SL and FL are frequently encountered from humus litter. They generally appeared in association with cellulose and lignin decomposing fungi at the late stage of litter decomposition (Hering, 1965). Although they were frequently isolated from soil (Widden, 1986), they were not less common on humus litter (Visser and Parkinson, 1975). The floristic composition of decomposing litter was strongly determined by the selective nature of the substrate (Chapella and Boddy, 1988). Therefore, lesser number of fungal species were encountered on PDL and HL compared to SL and FL (Table 1).

Contribution in abundance by different fungi changed as the litter underwent decomposition. Certain fungi which were predominant in all isolations in SL and FL decreased in percentage abundance in PDL and disappeared in HL. *Cytosporina* sp. and *Pestalotia* sp., two top ranking fungi of SL and FL, were shifted in position to 17 and 15 respectively in PDL and were completely absent in HL. They were mostly primary saprophytes (Hudson, 1968) and colonised the litter at the early stage causing partial decomposition (Garrett, 1963).

Trichmoderma viride, which occupied 9th position in order rank and is poorly represented in SL, increased in percentage abundance in PDL and HL occupying the first position in order rank.

Table 2: Percentage abundance of some dominant fungi (above 2.0%) with their relative ranks (Average of 02 years)

Fungi	*Senescent leaf*			*Fresh litter*			*Partially decomposed litter*			*Humus litter*		
	No. of Colony	*% Abundance*	*Rank*	*No. of Colony*	*% Abundance*	*Rank*	*No. of Colony*	*% Abundance*	*Rank*	*No. of Colony*	*% Abundance*	*Rank*
Absidia butleri	–	–	–	–	–	–	15	0.64	19	45	1.76	16
A. glauca	–	–	–	–	–	–	125	5.3	06	256	10.04	03
A. spinosa	–	–	–	–	–	–	19	0.81	18	114	4.47	08
Alternaria alternata	91	5.05	06	60	3.18	07	–	–	–	–	–	–
Aspergillus awamori	174	9.65	03	150	7.96	03	300	12.72	02	235	9.22	04
A. flavus	–	–	–	20	1.06	18	13	0.55	20	54	2.12	15
A. fumigatus	126	6.99	04	54	2.86	08	114	4.83	09	97	3.8	10
A. niger	88	4.88	07	126	6.68	04	213	9.03	05	226	8.86	05
A. terreus	14	0.78	15	38	2.02	12	–	–	–	–	–	–
Cladosporium cladosporioides	75	4.16	08	109	5.78	05	120	5.09	07	76	2.98	13
C. oxysporum	48	2.66	13	35	1.86	13	–	–	–	–	–	–
Cunninghamella verticillata	–	–	–	–	–	–	120	5.09	08	88	3.45	11
Curvularia eragrostidis	53	2,94	12	24	1.27	17	50	2.12	13	–	–	–
C. lunata	94	5.21	05	107	5.68	06	36	1.15	14	–	–	–
Cytosporina Sp.	306	16.97	02	388	20.58	01	027	1.15	16	–	–	–
Fusarium Sp.	75	4.16	09	34	1.8	14	103	4.37	10	176	6.9	06
Mucor Sp.	–	–	–	–	–	–	–	–	–	109	4.27	09
Nigrospora Sphaerica	55	3.05	11	12	0.64	20	–	–	–	–	–	–
Penicillium citrinum	69	3.83	10	43	2,28	11	217	9.2	04	86	3.37	12
P. oxalicum	42	2.33	14	44	2.33	10	21	0.89	17	–	–	–
P. verruculosum	–	–	–	30	1.59	15	251	10.64	03	295	11.57	02
Pestalotia Sp.	309	17.14	01	283	15.0	01	31	1.31	15	–	–	–
Rhizopus nigricans	11	0.61	16	29	1.54	16	97	4.11	11	1.33	5.22	07
Syncephalastrum racemosum	–	–	–	18	0.95	19	57	2.42	12	40	1.57	17
Trichoderma viride	10	0.55	17	49	2.6	09	312	13.23	01	296	11.61	01

Trichoderma spp are known as the strongly cellulolytic fungi and are frequently recorded from F and H layers of litter (White et al., 1948). Increase in population density of *Rhizopus* sp., *Mucor* sp., *Absidia* spp, *Cunninghamella* sp. and *Syncephalastrum* sp. in humus litter as secondary saprophytes was mainly to utilise the product of cellulose and lignin breakdown. Saito (1956) also isolated species of *Absidia*, *Mucor* and *Trichoderma* from decomposed litter of F1 and F2 layers of beech forests. *Trichoderma* as one of the important member of F2 and H layers of ash, birch and aspen leaf litter has reported earlier (Hering, 1965; Visser and Parkinson, 1975).

From the present observation it was clear that dynamics of fungal composition, colonisation and population density greatly depended upon the litter types.

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