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Colonization of Microfungi during Degradation of Leaf Litter of *Saccharum officinarum L.*

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Abstract: **Decomposition is a central process in every ecosystem. Decomposers which decompose organic litter are bacteria, actinomycetes and fungi. In the present study only microfungi associated with decomposition of sugarcane (*Saccharum officinarum* L.) litter in agricultural fields have been investigated with a view to understand their ecology and biology during degradation of leaf litter. For this leaf litter have been collected from agricultural field and put into the pits for degradation in nylon mesh bags. These bags have been removed from the pits at regular time intervals of 15, 30, 45, 60, 75, 90, 120, 150, 180, 210, 240, 300 days. Spore suspensions were streaked over PDA and appeared fungi were identified. In all 48 fungal species with 26 genera have been identified and recorded. Identified genera have been classified according to their classes. Two genera belongs to class zygomycetes e.g. *Mucor* and *Rhizopus*, nine genera i.e. *Ceratocystis, Chaetomium, Cochliobolus, Corynascus, Emericella, Emericellopsis, Eurotium, Neosartorya* and *Sordaria* are belongs to class ascomycetes, two genera i.e. *Rhodotorula* and *Trichosporon* belongs to class basidiomycetes and remaining thirteen genera e.g. *Acremonium, Alternaria, Aspergillus, Candida, Cladosporium, Colletotrichum, Curvularia, Fusarium, Myrothecium, Paecilomyces, Penicillium, Phoma,* and *Trichoderma* are members of class deuteromycetes.**

Index Terms: **Colonization, Degradation, Microfungi, *Saccharum officinarum L.***

I. INTRODUCTION

Decomposition of litter is an important process of any ecosystem where degradation of complex organic compounds occur in simple organic or inorganic compounds adding them in nutrient cycling through physical, chemical as well as biological processes by micro-organisms viz. bacteria, fungi, actinomycetes etc (Cromack and Caldwell, 1992). They all act as the recyclers, which convert dead organic materials into simpler compounds and provide nutrients to the soil for plants growth. But among all the microbes, fungi are very important for the decomposition process (Dickinson and Pugh, 1974) because they have ability to produce wide range of extra cellular enzymes to change the chemical property of litter by many chemical reactions such as hydrolysis, oxidation, reduction and condensation (Waksman, 1952). The decomposition process of any ecosystem also depends on many other factors like temperature, climate, litter quality, soil type and different environmental conditions (Samingan, 2009).

The biochemical decomposition of litter is a sequential process in which different fungal species occurs at regular time intervals. Only certain types of fungal species are able to initiate the degradation process (Upadhyay, 2013) resultant loss of the less recalcitrant compounds like oligosaccharides, organic acids, hemicellulose and cellulose followed by degradation of remaining high recalcitrant compounds like lignin and suberin (Variskova and Baldrian 2013). During the course of transformation, litter quality has also been changed. In this way decomposing litter helps in recovery of soil fertility as well as enhances its productivity.

The ability of fungi to decompose the leaf litter have been investigated by many workers (Pugh 1958, Hudson 1962, Frankland 1976 & 1998, Osono & Takeda 2005 and 2006) on different plant species.

In the same way the present investigation of fungal colonization on leaf litter of *Saccharum officinarum L*. provides basic information on diversity and effect of fungal colonies on leaf litter during the different stages of decomposition process. The study was carried on sugarcane crop because it is widely

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cultivated sugar rich commercial crop in the world. Therefore it leaves plenty of litter in waste form in its cultivation area. During the decomposition process its leaf litter provide substrate for fungal colonization. At early stage of decomposition process only sugar fungi are able to colonize followed by fungi which were able to utilize cellulose, hemicellulose and lignin respectively.

II. MATERIAL AND METHODS

A. Collection of sample

Sonagir block of Datia district popularly famous for Jain temples has been selected for collection of litter samples because of major sugarcane growing areas. Collected samples were brought to laboratory from the agricultural field in polythene bags.

To study of diversity of fungi during the process of decomposition of sugarcane litter, the litter bag method (Crossley and Hoglund, 1962) was followed. For this purpose 24 nylon bags were prepared. Equal amount (5gm) of litter was placed and bags were kept in pits of 2ft×2ft×2ft dimension. Bags were taken out from the pits at regular intervals of 15, 30, 45, 60, 75, 90, 120, 150, 180, 210, 240 and 300 days of incubation in pits. Sample from each bag was divided into two halves, one for biochemical analysis and another for isolation purpose.

B. Isolation of fungi

Sugarcane litter was cut into small pieces. From these pieces suspension was prepared with double distilled water. Then Suspension was filtered with whatmann no. 1 filter paper. The filtrate was used as inoculate after serial dilution i.e. up to $1:10^3$. 1.0 ml of suspension was then streaked over PDA i.e. Potato dextrose agar media (Potato 200.0g, Dextrose 20.0g, Agar 15.0g, pH 5.5 and double distilled water 1000ml). Inoculated Petri plates were incubated at 27ºC ± 1ºC. After 72 hrs of incubation, number of colonies appeared which were then sub cultured to obtain pure culture (monoculture) of fungi. These plates were maintained at 4ºC for further study.

Each Petri plate was then used for identification. For identification, microscopic studies have been carried out by using lactophenol cotton blue mount. Each slide was then observed under binocular microscope (Olympus) using 15X and 45X eye piece and objective.

Fungal strains have been identified on the basis of their appearance, growth, morphological and microscopic characteristics observed under microscope using standard photograph and literature (Nagamani *et al* 2006).

III. OBSERVATION

During present study twenty six fungal genera along with different forty eight fungal species have been identified and observed during degradation of leaf litter of *Saccharum officinarum.* After their identification details of genera with their respective species are presented in table –I.

A. Morphological Description of Identified Fungal Strains

Acremonium implicatum Gilman & Abbott. Colonies moderately grow on PDA in 3-5 days, white at first and becoming pale pink at maturity, floccose, loose textured; conidiophores when present short, simple, narrowed towards the tip, erect, smooth and arising from aerial hyphae; conidia one celled, fusiform to ellipsoidal, hyaline, smooth, produced in very long chains which become tangled in age.

Alternaria alternata Keissl**,** Colonies grow on PDA in 3-5 days, effuse, grey, dark, olive brown to black; without aerial mycelium; conidiophores simple, irregularly or loosely branched, 3-4 septate simple straight; conidia forming often in long branched chain of 2-10 or moriform with 3-8 transverse septa, walls rough in lower part with longitudinal or oblique septa, ovoid, ellipsoidal, often with a short or cylindrical beak, medium golden brown.

Alternaria longipes Ellis & Everh, Colonies grow on PDA in 3-5 days, brownish black in colour; conidiophores arising singly or in group, pale to olivaceous brown; conidia sometime solitary or in chains, straight or slightly curved, long, wide, pale to mid brown, 3-8 transverse septa sometime 2-3 longitudinal septa also present.

Aspergillus candidus Link. Colonies grow on PDA in 3-4 days, persistently white or becoming cream with age; reverse colourless or pale grey brown; conidial heads white, globose, often splitting in age; conidiophores colourless, slightly coloured at terminal area, smooth, thick walled; vesicles globose to subglobose, fertile over entire surface, phialides biseriate; metulae characteristically wedge shaped; conidia hyaline, globose to subglobose, thin walled.

Aspergillus fischeri Raper & Fennel. Growth of colonies variable, grow rapidly on PDA in 3-4 days, greyish green in colour, presenting a dissected appearance, characterized by abundant cleistothecia; conidiophores variable in length, vesicles flask shaped, pale to grey-green in colour, bearing phialides over ½ to ¾ of the vesicle; phialides uniseriate, crowded, dull green, conidia globose, delicately roughened, faintly pigmented, cleistothecia globose; asci 8- spored; ascospores globose, with two widely separated equatorial crests with convex surfaces bearing spin like projections.

Aspergillus flavus Link. Colonies grow rapidly on PDA in 3-4 days; conidial heads yellow to dark yellow green in age; heads of conidia radiate and splits into poor columns with large conidial heads; conidiophores arising separately from the substratum with heavy colourless walls and then gradually broaden to vesicles; vesicles may sometimes absent; uniseriate or biseriate phialides arise on metulae; conidia globose to subglobose, sometimes elliptical when young.

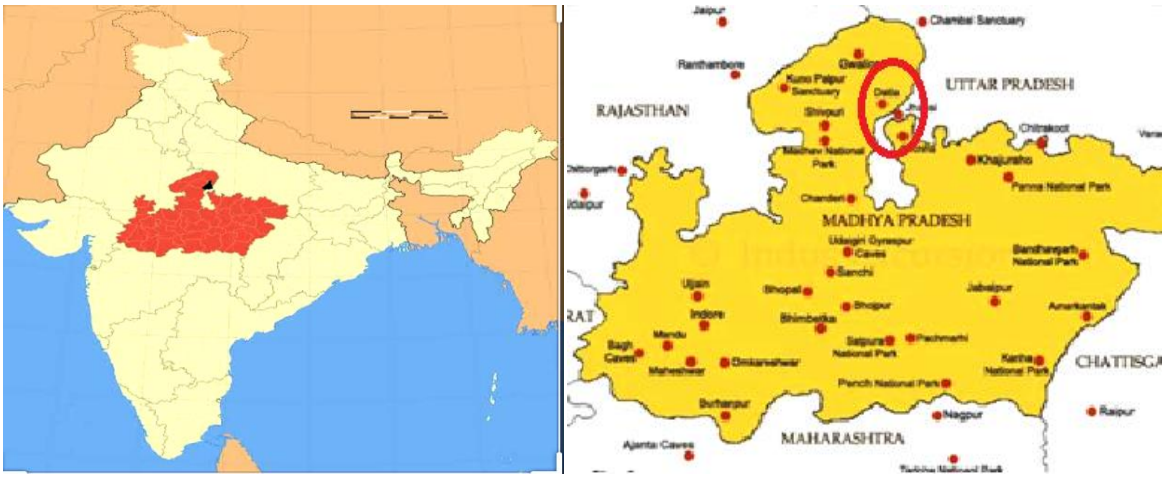


Fig 1. Map showing study site i.e. Datia district comes under Madhya Pradesh state of India.

(A) (B)

Fig 2. (A) Agriculture field of sugarcane crop. (B) Litter bags placed in the pits

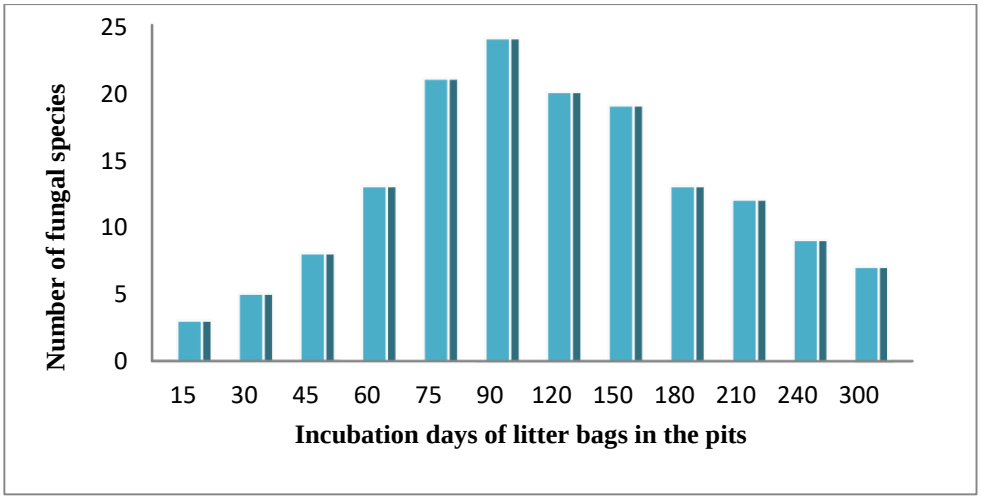


Fig 3. Showing occurrence of fungal species with respect to their incubation period

Table I: List of identified fungal strains during decomposition of *Saccharum officinarum L*. litter.

Identified Fungal strains	**Incubation Period (Days)**											
	15	**30**	**45**	**60**	**75**	**90**	**120**	**150**	**180**	**210**	**240**	**300**
Mucor hiemalis	+	+	+	+	+							
Rhizopus stolonifer	+	+	+	+	+	+						
Aspergillus flavus	+	+	+	+	+	+	+	+	+	+	+	
Aspergillus niger	+	+	+	+	+	+	+	+	+	+	+	+
Penicillium chrysogenum		+	+	+	+	+	+	+	+			
Aspergillus flavipes			+	+	+	+	+					
Acremonium implicatum				+	+							
Cladosporium sphaerospermum				+	+	+	+					
Chaetomium osmanae				+	+	+	+					
Chaetomium spirale				+	+	+	+					
Aspergillus japonicus				+	+	+	+	+				
Aspergillus nidulans				+	+	+	+	+				
Tricoderma viride				+	+	+	+	+	+	+	+	+
Penicillium digitatum					+	+						
Chaetomium convolutum					+	+						
Chaetomium globosa					+	+	+					
Emericellopsis minima					+	+	+					
Phoma fameti					+	+	+					
Alternaria alternata					+	+	+	+				
Curvularia lunata					+	+	+	+				
Fusarium oxysporum					+	+	+	+				
Aspergillus stellatus						+						
Eurotium amstelodami						+						
Penicillium herquei						+	+					
Chaetomium mollicellum						+	+					
Chochliobolus hawaiiensis						+	+	+				
Emericella nidulans						+	+	+				
Sordaria fumicola						+	+	+	+			
Ceratocystis paradoxa							+					
Chochliobolus tuberculata							+					
Candida albicans							+	+				
Aspergillus fischeri							+	+	+			
Aspergillus fumigatus							+	+	+	+		
Aspergillus unguis								+				
Pecilomyces variotii								+				
Penicillium decumbens								+	+			
Colletotricum dematium								+	+	+	+	
Neosartorya glabra								+	+	+	+	+
Trichosporon aesteroides									+			
Aspergillus tamarii									+	+		
Myrothecium gramineum									+	+		
Fusarium endophthalimistis									+	+		
Aspergillus candidus									+	+		
Corynascus sepedonium										+	+	+
Chaetomium salami										+	+	+
Alternaria longipes											+	+
Rhodotorula glutinis											+	+
Chaetomium aurium											+	+

Aspergillus flavipes Thom & Church**.** Colonies grow moderately on PDA in 3-4 days; colonies are white and change to bright wheat colour with age. velvety; reverse usually in yellow brown to red brown, periphery white; exudates usually abundant; conidial heads mostly columnar, pale avellaneous shades; conidiophores smooth, yellow to light brown; vesicles subglobose to vertically elongate, phialides biseriate; conidia subglobose nearly colourless; smooth, hulle cells sometimes present.

Aspergillus fumigatus Fresen. Colonies spread on PDA in 3-4 days, light blue-green in colour; hyphae are velvety to floccose, initially white then becoming colourless or varying in shades with time; conidial heads are compact columnar and may sometime densely crowded; conidiophores short, smooth, light green, septate, enlarging into a flask shaped vesicle; vesicle bearing a single series of phialides; which are closely packed; conidia globose to subglobose, green in mass, sclerotia and cleistothecia absent.

Aspergillus japonicus Saito, Colonies grow on PDA in 3-4 days, producing purple brown-black conidial heads, conidial heads variable, small, radiator split into indistinct columns; conidiophores arising from the substratum, walls are colourless and smooth; vesicles globose to elongate, fertile over the entire surface; phialides uniseriate; conidia mostly globose, sometimes subglobose, strongly echinulate, bright coloured at first, becoming purplish brown.

Aspergillus nidulans Fennell & Raper. Colonies grow well on PDA in 3-4 days; moderately yellow green in colour with many conidial heads; conidial heads are thick walled with globose to subglobose in shape; asci subglobose to ovate, 8 spores; ascospores are lenticular, reddish orange with two prominent pleated equatorial crests with convex surface .

Aspergillus niger Tiegh. Colonies grow on PDA with abundant mycelium; conidial heads carbon black to brownish black and may change to pale yellow; conidial heads large and black at first globose or may sometime split into well defined columns with age; conidiophores arising directly from the substratum, smooth, non septet, thick walled; vesicles globose, walls thick, bearing two series of fully packed phialides, brown in colour; conidia globose, spinulose with colouring substance, black in colour, globose to subglobose sclerotia have been reported in some strains.

Aspergillus stellatus Curzi. Colonies grow on PDA in 3-5 days; green conidial heads are produced from submerged vegetative mycelium; cleistothecia large, green and may change to grey with age; conidiophores arising from the substratum, straight, smooth variable in length; conidia globose, light green in colour ascospores orange-red to purple-red.

Aspergillus tamarii Kita, Colonies grow on PDA in 3-4 days, olive brown when young, brownish green or brown with age; conidial hyphae globose to loosely radiate with chain divergent or adhering in loose thin columns; conidiophores of variable size arising from submerged hyphae; vesicles globose to subglobose; phialides biseriate or uniseriate; conidia globose to subglobose at maturity.

Aspergillus unguis Thom & Raper. Colonies grow on PDA in 3-5 days; yellowish green to dark green in colour. Sterile hyphae thick walled, conidial heads columnar; conidiophores smooth, dull brown; vesicles hemispherical; phialides biseriate; conidia globose, dull green; asci 8-spored, ovoid to subglobose; ascospores lenticular.

Candida albicans Robin. Colonies grow on PDA in 3-5 days, white to cream in colour; mycelium largely submerged; pseudohyphae and true hyphae are also observed; budding cells of varying shapes, produced along hyphae at the point of septa, usually round and short oval; chlamydospores round, large, thick-walled and usually terminal.

Ceratocystis paradoxa Moreau. Colonies grow on PDA in 3-6 days, dark blackish brown to black; ascomata perithecial; perithecia globose with very long apical beaks; conidiophores colourless to pale brown; consisting of a short series of cylindrical cells with an upper most cell giving rise to an elongate conidiogenous cell; conidiogenous cells fragmenting to form arthroconidia, it is terminal and intercalary, cylindrical.

Chaetomium aureum Chivers. Colonies grow on PDA in 3-5 days, perithecium dark olive brown in colour and subglobose to oval in shape having with septate yellowish brown terminal hairs, septate, smooth to finely verrucose, straight or mostly accurate with blunt tip, lateral hairs straight to slightly curved, yellowish-brown, asci club shaped, 8- spored; ascospores olive brown to olive green, ovate, boat spindle shaped, occasionally flat on one side.

Chaetomium convolutum Chivers. Colonies grow on PDA in 3-5 days, perithecia light brown, subglobose to ovate; terminal hairs straight below, becoming undulate to loosely coiled or lightly coiled, dark brown below, lighter at the tip, septate; lateral hairs brown, straight, septate, finely roughened; asci club shaped, ascospores ovoid, ellipsoidal, lightly coloured, slightly apiculate at one or both ends.

Chaetomium globosum Kunze. Colonies grow on PDA in 3-5 days; perithecia olive green to greyish green, globose to subglobose, thickly covered with hairs; which are rough, septate and light colour. Forming a dense inter- woven bushy head; lateral hairs light coloured, finely roughened; asci oblong, clavate; ascospores dark, lemon shaped, broadly ovoid.

Chaetomium mollicellum Ames. Colonies grow on PDA in 4-5 days; perithecia dark grey, globose or ovate, fixed to the substratum by delicate rhizoids, rounded at base and densely covered with hairs; terminal hairs of 2 types straight and spiral, straight at the base and spiral at the apex and another type long,

straight to undulate brown and septate. lateral hairs few, long pale brown, septate; asci long cylindrical; ascospore brown at maturity, ellipsoid in shape.

Chaetomium osmaniae Rao & Reddy. Colonies grow on PDA in 3-5 days; pale olive colour to dark olive dark at maturity; perithecia dark brown, subglobose to ovoid, attached to substratum by olive brown rhizoids; terminal and lateral hairs alike, myceloids, unbranched, obscurely septate; asci club shaped; ascospores elliptical to fusiform, brown in colour.

Chaetomium salami Rao. Colonies grow on PDA in 3-5 days; pale round body; perithecia subglobose to ovate; pale brown, covered with delicate hairs all round when young but more hair at maturity;terminal and lateral hairs often similar and indistinguishable, myceloid, unbranched; asci clavate to obovate; ascospores brown, subglobose or irregular in shape.

Chaetomium spirale Zopf. Colonies grow on PDA in 3-5 days. pale to greenish coloured; Perithecia dark brown to black, scattered, globose to subglobose, covered densely with hairs, terminal hairs straight , fading above with uniform diameter at the tip septate ending in a rounded tip; lateral hairs straight, fading and tapering above, septate, dark brown; clubbed shaped asci; ascospores, lemon shaped, apiculate at both ends, light to dark brown in colour.

Cladosporium sphaerospermum Penz; Colonies grow on PDA in 3 to 5 days; olive green, becoming olivaceous brown at maturity, velvety, reverse greenish-black; conidiophores macronematous and micronematous, variable in length, producing conidial chains; conidia spherical or subspherical. mid to dark olivaceous brown.

Cochliobolus hawaiiensis Alcorn. Colonies grow on PDA in 3-4 days; dark grey to blackish in colour; pseudothecia black, base globose, neck long, straight, cylindrical; asci cylindrical, rounded at the apex; ascospores hyaline, filiform, apex acute; conidiophores simple, slightly geniculate, pale to mid- brown, septate; conidia straight, ellipsoidal, oblong or cylindrical.

Cochliobolus tuberculatus Sivan., Colonies grow on PDA in 3-5 days, blackish brown in colour, stromata simple or branched; pseudothecia black, globose,; asci cylindrical, short staked; ascospore filiform, hyaline, helically coiled in the ascus; conidiophores macro or mononematous, unbranched, terminal, cylindrical; conidia straight, ovoid, oblavate or ellipsoidal, pale to dark brown, mature conidia tuberculate, young conidia sub hyaline and smooth walled.

Colletotrichum capsici Butler & Bisby. Colonies grow on PDA in 3-5 days; aerial mycelium were whitish to dark grey in colour; conidia are pale buff to salmon; with abundant setae which are long, rigid, bristle like septate, dark below, lighter above; conidia falcate, fusiform, apices acute; appressoria abundant, medium-brown, clavate to circular, edge usually entire.

Corynascus sepedonium Emmons. Colonies grow on PDA in 4-6 day, become golden-yellow with the production of conidial masses; ascomata globose, dark brown, at maturity wall composed of a layer of flattened cells; asci obovate or nearly spherical; ascospores brown, smooth walled, ellipsoidal to fusiform; conidia formed singly on short denticles at the tips of small ampulliform conidiogenous cells.

Curvularia lunata Ellis.Colonies grow on PDA in 3-5 days, dark grey in colour; stromata regularly and abundantly formed in culture; mycelium branched, septate with long conidiophores; conidia are curved ellipsoidal having with 2-3 septa, middle cells broad and darker than other cells, middle septum not median, hilum not protuberant.

Emericella nidulans Eidam. Colonies grow on PDA in 3-6 days; somewhat velvety, cress green in colour from abundant conidial heads, changing from deep dull to reddish; conidial heads loosely radiate when young; conidiophores light brown smooth and occasionally septate; conidia globose to subglobose; cleistothecia abundant, globose to subglobose; asci numerous in each cleistothecia, globose to subglobose; ascospores purple-red, lenticular,smooth with two equatorial crests.

Emericellopsis minima Stolk**,** Colonies grow on PDA in 5-7 days, submerged mycelium solid pellicle, pale salmon to salmon, moist; ascomata not cephalothecoid; cleistothecia produced on most media on surface or submerged, globose, glabrous, brown to black; asci numerous, sessile, evanescent, 8 spored; ascospores one celled, ellipsoidal to elliptical, longitudinal winged appendages , hyaline when young, olive brown in maturity.

Eurotium amstelodami *L.* Mangin. Colonies grow on PDA in 3-6 days, plane, conidial heads dirty green to yellow becoming brown in age; cleistothecia scattered, bright yellow; vesicles subglobose to elliptical; phialides uniseriate; asci subglobose to globose; ascospore lenticular, convex rough surface.

Fusarium oxysporum Schlecht. Colonies grow on PDA in 3-4 days; mycelium white or peach; conidiophores unbranched or scantly branched, monophialidic; microconidia are with more in number and small in size; produced simple lateral phialides, solitary on free conidiophores never form in chains; macroconidia are septated 2-5, spindle to fusiform, curved or almost straight, pointed at both the ends, definite or weakly pedicellate; sometime terminal globose, smooth or roughned clamydospores have been observed.

Fusarium endophthalimitis colonies grow on PDA in 3-5 days; mycelium white in colour, conidiophores unbranched; conidia abundant ellipsoidal or kidney shaped, septate, pointed at both the ends.

Mucor hiemalis Schipper, Colonies grow on PDA in 3-4 days, white later in grey; sporangiophores with long sympodial branches originating a short distance below the previous sporangia; sporangia globose, blackish brown, wall diffluent, leaving a basal collarette; columellae globose or oval; sporangiophores variable in shape, cylindric-oblong;

chlamydospores numerous at the point of contact with the substrate.

Myrothecium gramineum Lib. Colonies grow on PDA in 4-5 days; spore mass shiny, black, wet, enclosed by thin marginal hyphae and hyaline setae; black stipe in synnemata composed of elongated conidiophores clothed by marginal hyphae with setae arising at the base; mycelium absent or floccose white to pale rosy buff, sporing areas black, usually coalesced into sporodochia, hyphae hyaline, thin walled, rarely branched, septate cells; stroma usually well developed, sometimes partially embedded in the host, cells hyline elongated to isodiametric, closely compacted; Conidiophores closely compacted, repeatedly branched, bearing phialides; hyline, smooth walled, longer cell found in synnemata; phialides 2-4 in a whorl, closely compacted in a dense parallel row or spreading slightly in synnemata.

Neosatorya glabra Fennel & Raper. Colonies grow on PDA in 3-6 days. cleistothecia abundant, at first white becoming pale yellow to buff in age; conidial structure limited; conidial heads columnar; vesicles flask shaped, faintly to definitely grey-green coloured, bearing phialides over upper 1/2 to 3/4 , phialides crowded, pale to dull green; conidia typically subglobose, pale blue green in mass; ascospores lenticular.

Paecilomyces varioti Nainier. Colonies grow on PDA in 3-5 days; initially velvety but become powdery at maturity; chladospores borne singly or in short chain, more or less globose; metulae divergent; phialides irregularly distributed along the fertile hyphae; conidia elliptical in shape with yellowish to brown, smooth walled, very unequal in size.

Penicillium chrysogenum Thom. Colonies grow on PDA in 3-4 days; mycelium at the margin white , blue green; conidiophores born from surface or subsurface hyphae, smooth, terminal or sometime subterminal and divergent; phialides ampulliform ; conidia ellipsoidal to subspheroidal, smooth, born in long irregular columns.

Penicillium decumbens Thom. Colonies grow on PDA in 3- 4 days at 25°C; mycelium white to cream; conidiation light to moderate, greyish green to dull green; conidiophores born from aerial hyphae; phialides long and slender, ampulliform; conidia ellipsoidal, smooth, born in short loose columns.

Penicillium digitatum Pers. Colonies grow on PDA in 3-4 days.mycilium white; conidiation moderate to heavy, greyish green to olive; conidiophores born from surface or aerial hyphae; phialides ampulliforn to cylindrical; conidia born as cylinders, later ellipsoidal to cylindrical, smooth.

Penicillium herquei Bainier & Sartory. Colonies grow on PDA in 3-5 days, mycelium light yellow, brilliant green or yellowish green at the center; sclerotia produced by some strains; conidiation light to moderate; exudate usually produced, pale to bright yellow, conidiophores borne from surface or aerial hyphae; phialides in verticils of 6-10, ampulliform; conidia usually ellipsoidal to apiculate.

Phoma fameti Brunaud, Colonies grow on PDA in 4-6 days, aerial mycelium white, zonate or azonate, branched, translucent/ pale brown; mycelium immersed, branched septate hyaline or pale brown; reverse buff, yellow, saffron; conidia unilocular, rarely multilocular, globose, separate or aggregated, pale or medium brown; ostioles with single sometime multi-ostiolate conidiation have also been observed. Conidiophores present in few species only; conidia slimy, hyaline, aseptate or occasionally one septate, ellipsoid, cylindrical, fusiform, pyriform or globose, smooth.

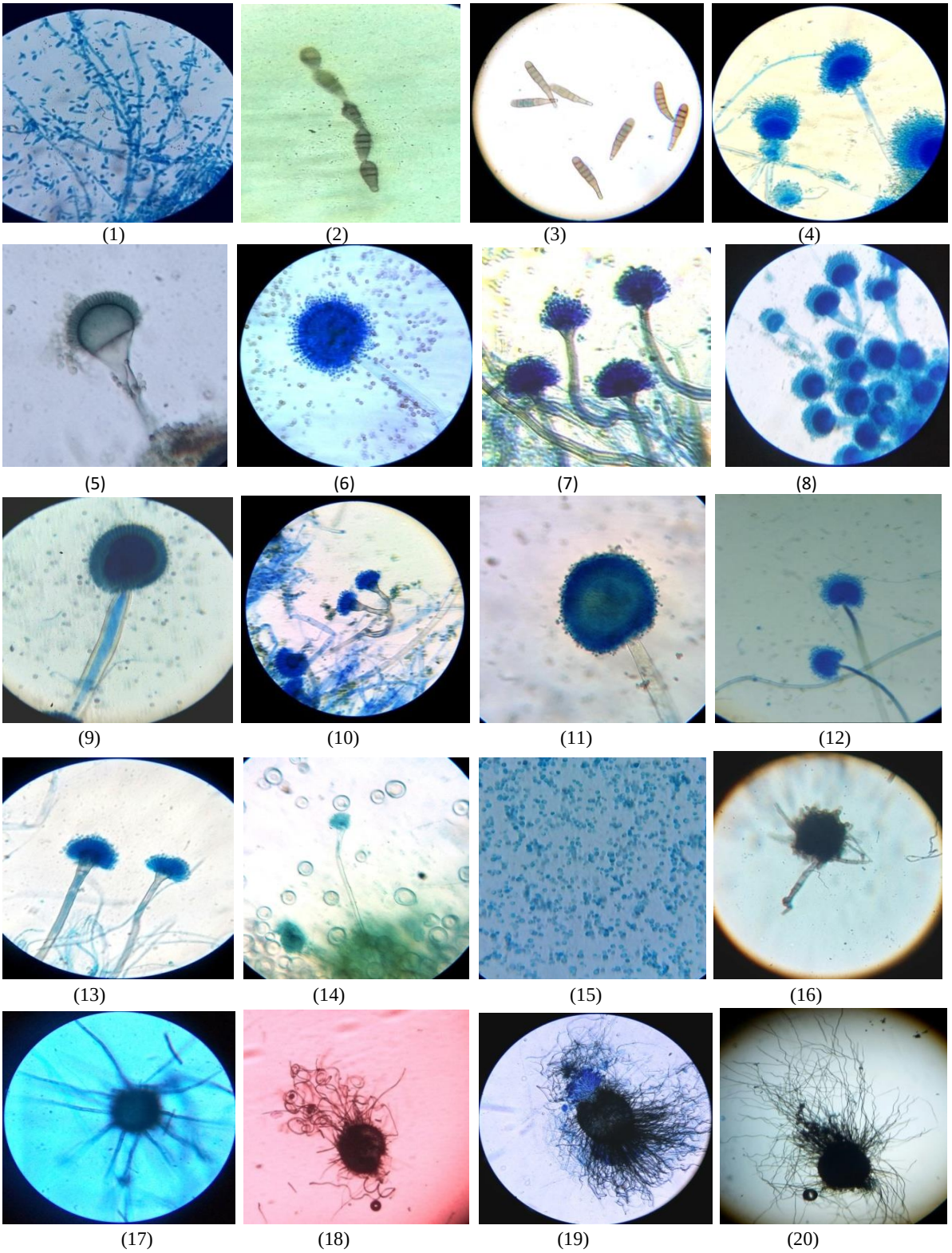
Rhizopus stolonifer Ehrenberg. Colonies grow on PDA in 3-4 days; initially white then turn to brownish black in colour, stolons spreading outside with brown internodes; internodes are branched and brown rhizoides are appear from the nodes, unbranched soorangia are cluster of 3 to 10 which are white then may become pale to dark brown at maturity; sporangiospores irregular, round to oval, angular, straight, grey, striate; zygospores round to oval, exine brown-black, verrucose; clamydospores absent.

Rhodotorula glutinis Harrison. Colonies grow on PDA in 3-5 days, pink to coral in coral coloured, pasty, smooth; mycelium largely submerged; pseudohyphae rarely present; budding cell (blastoconidia) round, oval and sometime elongate in shape; chlamydospores round, large and thick walled.

Sordaria fumicola Desm. Colonies grow on PDA in 4-6 days, mycelium spreading and submerged, branched, septate; perithecia generally crowded, superficial glabrous, brown or black, variable in size, asci unitunicate, short-stipitate, attached to the base; ascospores obliquely uniseriate, dark brown, ellipsoidal with rounded ends.

Trichoderma viride. Pers. Colonies grow rapidly on PDA in 3-4 days, green or dark green in colour, floccose to arachnoid, somewhat whitish; chlamydospores are white common, intercalary or terminal; conodiophores are branched and arise in compact or loose tufts, main conidiophores large, producing smaller side branches, ultimately a conifer like branching system is form; phialides form in false whorls, generally not more than 2 or 3; conidia globose or short obovoid, or broadly ellipsoidal.

Trichosporon aesteroides Asahii. Colonies grow on PDA in 3-5 days; white to cream in colour; pseudohyphae and hyphae both are abundantly produced; blastoconidia unicellular and variable in shape; produce arthroconidia; arthroconidia unicellular, cubical, barrel shaped.



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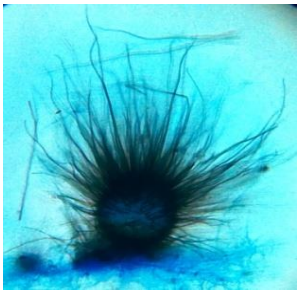
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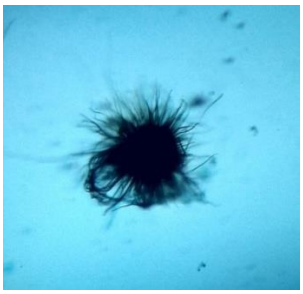
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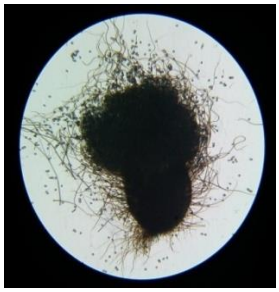
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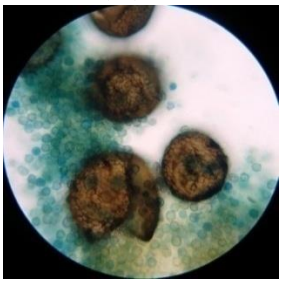
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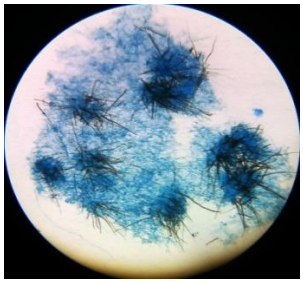
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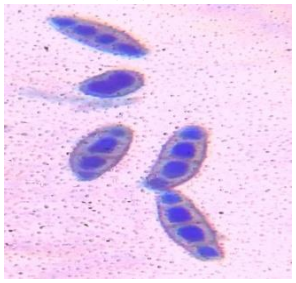
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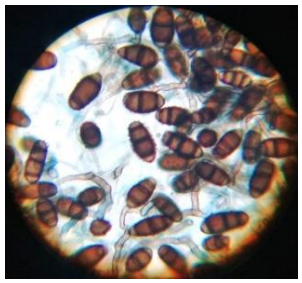
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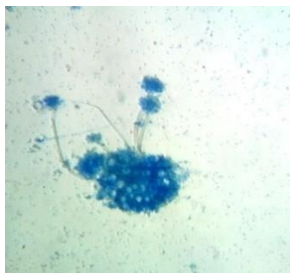
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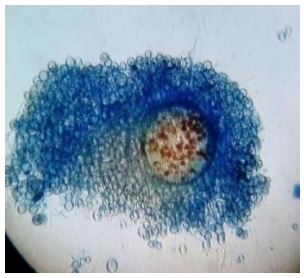
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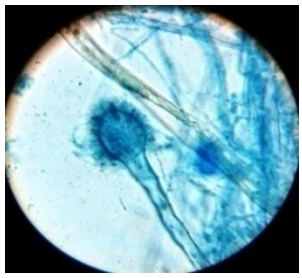
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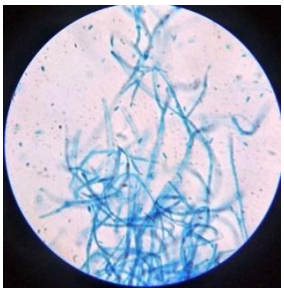
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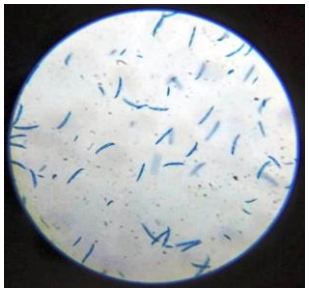
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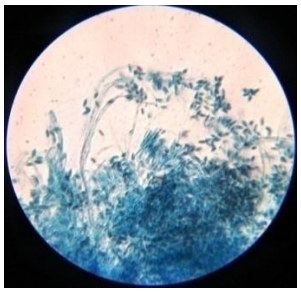
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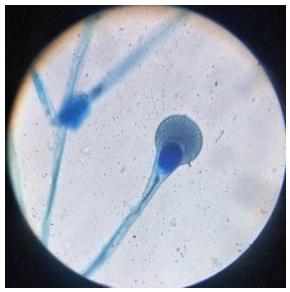
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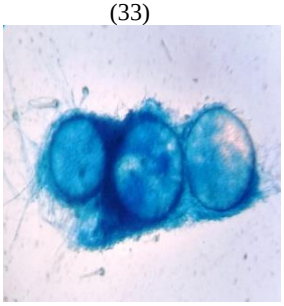
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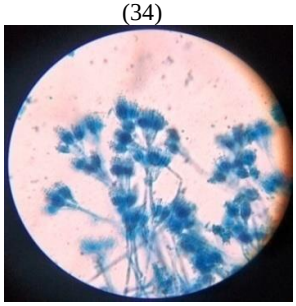
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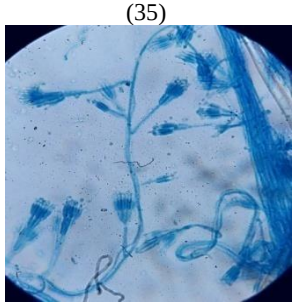
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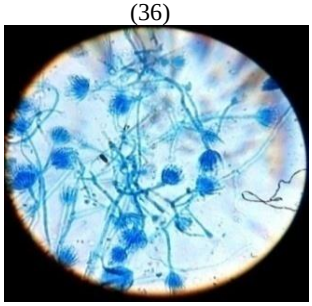
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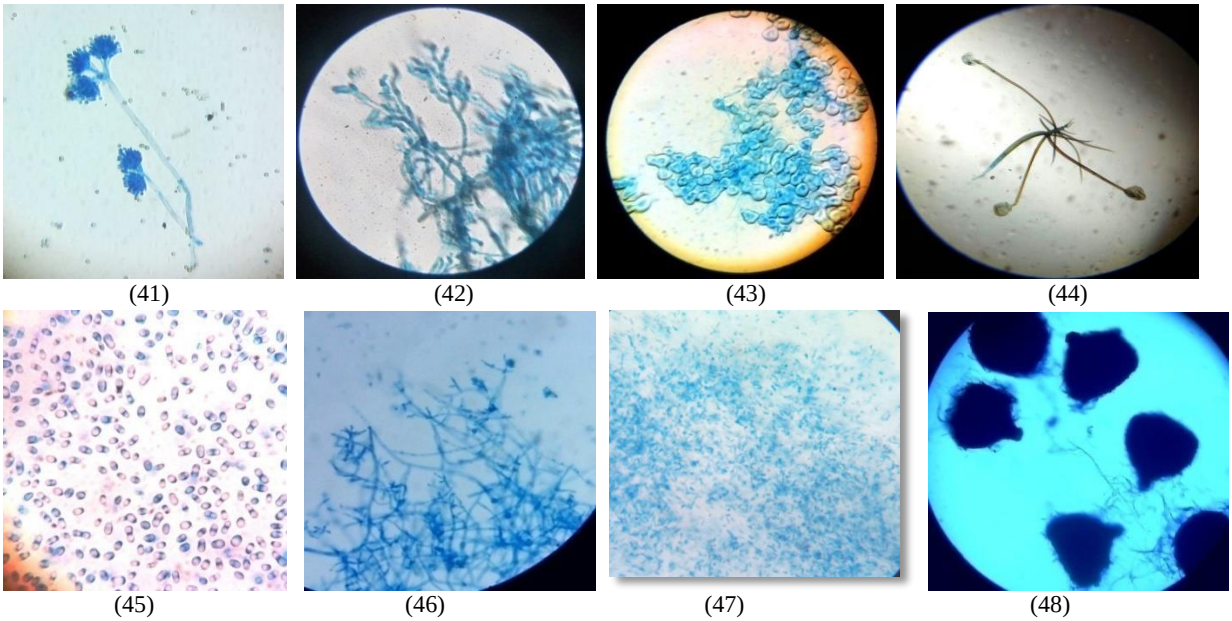

Fig. 4- Fungi isolated and identified from litters of *Saccharum officinarum L.* (1) *Acremonium implicatum* (2) *Alternaria alternata* (3) *Alternaria longipes* (4) *Aspergillus candidus* (5) *Aspergillus fischeri* (6) *Aspergillus flavus* (7) *Aspergillus flavipes* (8) *Aspergillus fumigates* (9) *Aspergillus japonicas* (10) *Aspergillus nidulans* (11) *Aspergillus niger* (12) *Aspergillus tamarii* (13) *Aspergillus unguis* (14) *Aspergillus stellatus* (15) *Candida albicans* (16) *Ceratocystis paradoxa* (17) *Chaetomium aurium* (18) *Chaetomium convolutum* (19) *Chaetomium globosum* (20) *Chaetomium osmanae* (21) *Chaetomium molisenum* (22) *Chaetomium salami* (23) *Chaetomium spirale* (24) *Cladosorium sphaerospermum* (25) *Corynascus sepedonium* (26) *Colletotrichum dematium* (27) *Cochliobolus hawaiiensis* (28) *Chochliobolus tuberculata* (29) *Curvularia lunata* (30) *Emericella nidulans* (31) *Emericellopsis minima* (32) *Eurotium amstelodami* (33)*Fusarium endophthalmistis* (34) *Fusarium oxysporum* (35) *Myrothecium gramineum* (36) *Mucor hiemalis* (37) *Neosartorya glabra* (38)*Penicillium chrysogenum* (39) *Penicillium decumbens* (40) *Penicillium Digitatum* (41) *Penicillium herquei* (42) *Pecilomyces varioti* (43) *Phoma fameti* (44) *Rhizopus stolonifer,* (45) *Rhodotorula glutinis.* (46) *Trichoderma viride* (47) *Trichosporon aesteroides* (48) *Sordaria fumicola*

IV. RESULT AND DICUSSION

During decomposition of leaf litter of *Saccharum officinarum L*. number of fungi belonging to different classes of kingdom mycota have been observed. In present study total 48 species of 26 genera of fungi have been isolated. Out of this 11 species of genus *Aspergillus,* 7 species of *Chaetomium,* 4 species of *Penicillium,* 2 species of *Alternaria, Cochliobolus* and *Fusarium,* one species of each genera of *Acremonium, Candida, Ceratocystis, Cladosporium, Corynascus Curvularia, Colletotrichum, Emericella, Emericellopsis, Eurotium, Mucor, Myrothecium, Neosartorya, Pecilomyces, Phoma, Rhizopus, Rhodotorula, Trichoderma, Trichosporon* and *Sordaria* reported.Their periodic appearance have been recorded in the table 1. Which shows that fungi appears in a pattern. Similar results have also been reported by Hudson (1968), Dix and Webster (1985), Senthil Kumar *et al* (1993), Promputtha *et al* (2002). It has also been observed that amongst all the fungi genus *Aspergillus* (11) is the most dominant followed by genera *Chaetomium* (07), and *Penicillium* (04), *Cochliobolus* and *Fusarium* (02) each. Clear conclusion can be drawn that early colonizers were the fungi which have ability to utilise simple sugar i.e. present in litters. While fungi that appears in later stages are the decomposers which degrade comparatively complex carbohydrates such as cellulose, hemicelluloses and lignin respectively (Garret 1963, Kirk *et al* 1980).

Identified fungal genera on the basis of their taxonomical characteristics are classified into 4 classes. Out of which 2 genera belongs to zygomycetes, 9 genera belong to ascomycetes class, 2 genera of basidiomycetes and rest of the 13 fungal genera belongs to deuteromycetes class. Most of the decomposers in the present study belongs to class deuteromycetes and ascomycetes followed by zygomycetes and basidiomycetes. Mehrotra and Aneja (1979) observed in their work on microbial decomposition of *Chenopodium album* litter and concluded that member of deuteromycetes and ascomycetes play active role in decomposition process and Borker (2014) also reported the similar observation when he isolated fungi from degrading biomass.

Colonization in the present study begins with saprophytes which give the way to other colonist with greater ability to degrade the litter (Jatav *et al* 2020). In the present study the initial colonizers were members of zygomycetes (Dwivedi and Shukla, 1977). It is also evident from table 1, 2, 3 and 4 that in the course of time, initial colonizers gradually disappeared or

replaced with new colonizers that requires different substrates. Similar findings have also been reported by Meridith (1962).

Besides this in the present study it is also observed that some fungal species i.e. *Aspergillus niger* and *Aspergillus flavus* were dominant in all the stages of degradation process which is indicative of high survivable ability of these fungal species during degradation process under adaptive conditions. On the other hand some species like *Eurotium, Pecilomyces, Trichosporon* etc were observed in very short period of decomposition suggesting their short survivability (Senthil Kumar *et al* 1993).

CONCLUSION

The present study shows that decomposition of litter continuously takes place throughout the year. The number of fungal species as well as the texture, colour and other chemicals composition of litter differed at different stages of decomposition process. The fungal species revealed less at initial stage gradually increased in the middle stage of decomposition process. In the later stage of decomposition the number of fungal species start decreasing again. Besides this, it is also observed that the occurrence of fungal population also showed seasonal variations. Such as the number of fungal species were found maximum in rainy season as compared to summer. While some fungal species like *Aspergillus spp., Chaetomium spp*., *Penicillium spp.* appeared throughout the decay process.

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