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Article

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Diversity of macrofungi and its distribution pattern of Gorakhpur District, Uttar Pradesh, India

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Abstract

The present study deals with the status of macrofungal diversity in Gorakhpur district and its distribution pattern. The macrofungal survey was undertaken during 2011-2014 in different localities of Gorakhpur district. A total of 114 species of macrofungi belonging to 58 genera and 33 families were collected and identified in to 31 edible species, 10 excellent edible species, 68 inedible species and 5 poisonous species. Agaricaceae family was found to be the dominant representing 18 species. Distribution of macrofungal species in different localities of Gorakhpur district was also evaluated on the basis of Shannon diversity index, Simpson diversity index and evenness. Highest Shannon diversity index, Simpson diversity index and evenness were found to be 3.61, 0.97 and 0.90 respectively in Sahjanwan tehsil. The results indicate a very high species richness of the study site.

Key words – Agaricales – Basidiomycota – Diversity index – Edible macrofungi

Introduction

Macrofungi are cosmopolitan, heterotrophic organisms that are quite specific in their nutritional and ecological requirements. Macrofungi occupy important place in the biodiversity of India. Macrofungi (also called mushrooms) are represented by 41,000 species across the globe out of which only ~2% have been reported from India, despite the fact that one-third of the total global fungal diversity exists in the tropical Indian region (Priyamvada et al. 2017). Many Asian countries use traditionally wild edible mushrooms as delicious and nutritional food and medicine. Wild edible macrofungi are appreciated not only for texture and flavour but also for their chemical and nutritional characteristics (Tapwal et al. 2013).

From time to time different workers had studied macrofungal diversity from Northern part of India which includes North Western region, Eastern Himalaya proper and North Eastern hilly areas. Lots of macrofungi were collected from Himachal Pradesh by Sohi et al. (1964, 1965). Ghosh & Pathak (1965) collected 3 species of *Macrolepiota* from Lucknow (U.P.), Ghosh et al. (1967) also described about some edible macrofungi of Lucknow. Chandrawati et al. (2014) collected 29 species of macrofungal belonging to 12 families from Gorakhpur while Vishwakarma et al. (2014) reported 12 taxa of macrofungi belonging to 8 families from here. Vishwakarma et al. (2017a) had provided a complete checklist of macrofungi of Gorakhpur district. Some works on nutritional property of macrofungi of this area were also carried out by Vishwakarma et al. 2016, 2017b.

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North Eastern part of Uttar Pradesh is endowed with a rich biodiversity of flora and fauna. It is situated in Terai region of Himalaya and hence provides suitable climatic and environmental condition for successful establishment of all types of flora especially the macrofungi. So the main aim of the present study was to explore and identify the macrofungal diversity of Gorakhpur district.

Materials & Methods

Study area

Gorakhpur is situated in North Eastern part of Uttar Pradesh. Gorakhpur district is a one of the major and largest district of Uttar Pradesh. Gorakhpur is the headquarter of Gorakhpur division and district both. Gorakhpur district is divided into seven Tehsils (Revenue Sub-division) presided over by a Sub-Divisional Magistrate. It occupies an area of about 7,483.8 Km^2 with latitude and longitude of 26°43' to 26°50'N and 83°20' to 83°27'E respectively. The annual average temperature is 25-30°C. Gorakhpur region receives total annual average rainfall of about 1814mm, about 87% annual rainfall is received during warm rainy season and rest 13% is distributed in the form of occasional shower from November to May. Relative humidity ranges between 74-87%. The soil of this area is genetic alluvial brought down by river Rapti, Rohini, Ghaghara and Gandak from the Himalayas. It is situated on the basin of river Rapti and Rohini hence its geographical shape is a bowl type. Gorakhpur district has good vegetation cover and also have dense forest which is close to the foothills of Himalayas. All the areas of Gorakhpur district are rich in species composition of higher plants. North Eastern part of Uttar Pradesh with its varied topography, diverse vegetation and climatologically fluctuations can be successfully explored for the growth of macrofungi in wild habitat. In spite of the fact this region is rich in resources of edible macrofungi, no planned effort has been made so far to collect and conserve them. There is vast scope of edible macrofungi which grow wild in forests and grasslands of this region. The moderate rainfall in this part supports a rich flora. Collection of samples was done at tehsil level (which includes blocks and then villages). Different tehsil visited during the survey were Sahjanwan, Sadar, Khajni, Bansgaon, Campierganj and Gola.

Collection, identification and processing of macrofungi

Regular field trips were carried out in different places of Gorakhpur villages and forests, usually 4-5 times per months. Fruiting body/carpophores with stipe were picked up from substratum on which it was growing with the help of scrapper or knife or forceps and were wrapped individually in wax paper. Samples were photographed with proper scale in its natural habitats for its appropriate identification by using digital camera (Panasonic, DMC-F2). Place and date of collection, habit and habitat were noted down in the field diary at the time of collection and particular collection numbers was given to each specimen.

Samplings were done using quadrate method each measuring 20 × 20 m. Total of 28 sampling plots in the above 6 sampling sites were studied. Macrofungal specimens were preserved wet as well as dry following Ainsworth (1971). Fruiting bodies of macrofungi were preserved in solution of alcohol (15ml), formalin (25ml) and distilled water (100ml). Dry preservation of macrofungi were done by hot air oven at 40-50°C and stored in air tight zip lock polyethylene bags with naphthalene balls for further microscopic studies. The spore prints were taken according to the guideline given by Kuo (2001). Information regarding edibility and other uses of macrofungi species were collected by villagers, local inhabitants of the area and finally by consulting literature. Mycorrhizal associations were ascertained in species found just near the tree base by tracing out the root connection to the fructification.

Specimens were identified using the relevant literature (Alexopolous et al. 1996, Ellis & Ellis 1990, Jordan 1995, Moser 1983, Phillips 1981) and confirmed by mycokeys (www.mushroomexpert.com and www.mycokeys.com).

Data analysis

Diversity index of macrofungi was calculated as followed by Pushpa & Purushothama (2012).

Shannon diversity index for macrofungi was calculated by using following formula:

$$H = \Sigma \left(\frac{n}{N}\right) \ln \left(\frac{n}{N}\right)$$

H is the diversity index; N is the total number of individuals of all the species and n is the total number of individuals of particular species.

Simpson Index of Diversity=1-D

$$D = \Sigma n(n-1)/N(N-1)$$

D is the Simpson's index, N is the total number of individuals of all species and n is the total number of organism of a particular species

With the help of the values of diversity index, the evenness of the mushrooms was also calculated as

$$e = H/lnS$$

Where e is evenness, H is Shannon diversity index and S is the number of species

Results & Discussion

A total of 114 species of macrofungi belonging to 58 genera of 33 families were identified during the survey. Table 1 represents the list of collected species during the survey period and is arranged according to their representative families. Agaricaceae family (18 species) was found to be the most dominant while Clavariaceae, Geastraceae, Helotiaceae, Hygrophoraceae, Meripiliaceae, Meruliaceae, Mycenaceae, Russulaceae, Schizophyllaceae, Sparassidiaceae, Steraceae and Tuberaceae contains only one species each (Fig. 1).

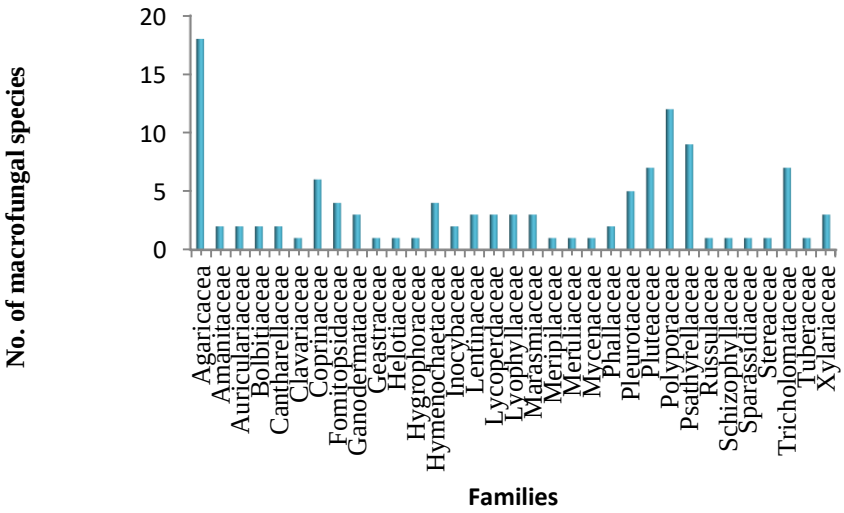

Fig. 1 – Family wise distribution of macrofungi in Gorakhpur district

The diverse climatic conditions of Gorakhpur make this area a natural habitat for a large number of macrofungi. Diversity of macrofungi varies greatly because of different ecological habitats viz., decaying wood logs, humid soil, sandy soil, humus, leaf litters etc. Mushrooms are seasonal fungi, which occupy diverse niches in nature in the forest ecosystem (Pushpa & Purushothama 2012). In present investigation (Fig. 2) the ecological preference of the species revealed that maximum number of (93) species were saprobic, 12 species were parasitic on higher trees, 6 coprophilous and 3 were symbiotic. The abundance of macrofungi on different substrate greatly depends up on the organic and nitrogenous content of the soil and also on the other nutrients factors which plays key role in the growth of fungi (Kumar et al. 2013).

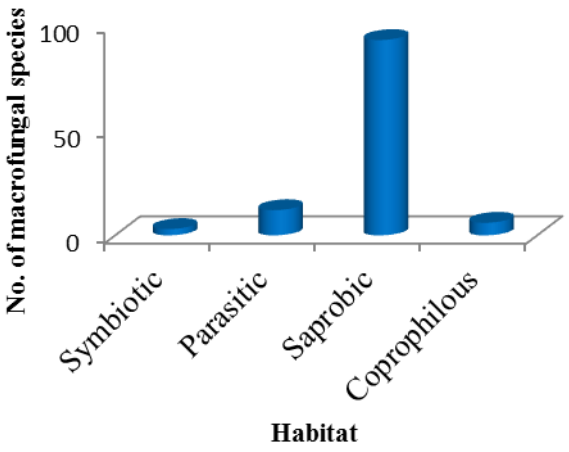

Fig. 2 – Distribution of different macrofungi groups

The survey related to the edibility status of macrofungi was also undertaken and the result revealed that out of 114 macrofungal species collected 31 macrofungal species were found to be edible, 10 excellent edible, 68 inedible while 5 poisonous (Fig. 3). Species such as *Agaricus*, *Calocybe*, *Pleurotus*, *Termitomyces*, *Tuber* and *Volvariella* are considered highly delicious. The usage of these macrofungi both commercially and domestically may be due to their appealing taste, frequent occurrence and the fact that they are easily identified by the local peoples as safe for consumption. Macrofungi contains high nutritive value. It contains low fat, rich in fibre, protein, minerals (Ca, P, K) and vitamins. It has high nutraceutical value which has created an interest of local peoples towards its use (Abolfazi & Janardhana 2012).

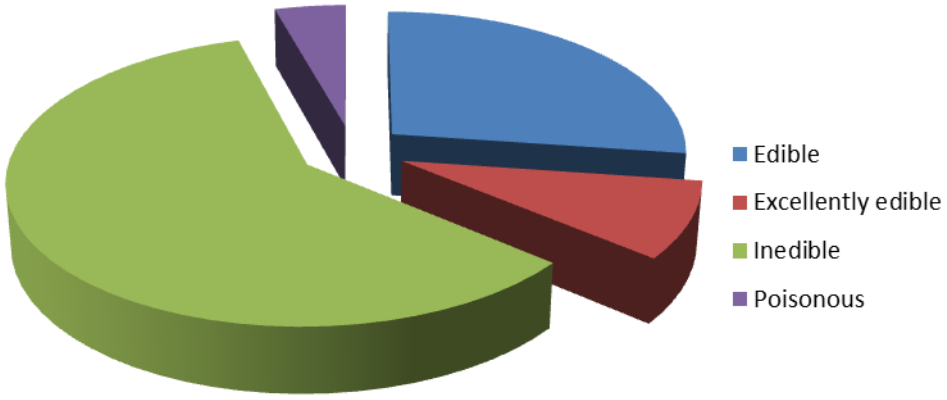

Fig. 3 – Edibility status of collected macrofungi in per cent

Diversity of an area is greatly affected by the environmental condition experience by that particular habitat and this impart variation in occurrence of macrofungi in different seasons. It is clear from the fig 4 that during four year of survey greater number of species were recorded during the rainy season. Months of July followed by August and September each year (2011-2014) contains highest number of macrofungi, while there was complete absence of macrofungal species

in the months of January and November of all year (Fig. 5). In months of July, August and September the environmental conditions are very favorable for the growth of various macrofungi. Rainy season supports more macrofungal growth. Some woody macrofungi are present throughout the year while some occurs only at specific time of the year.

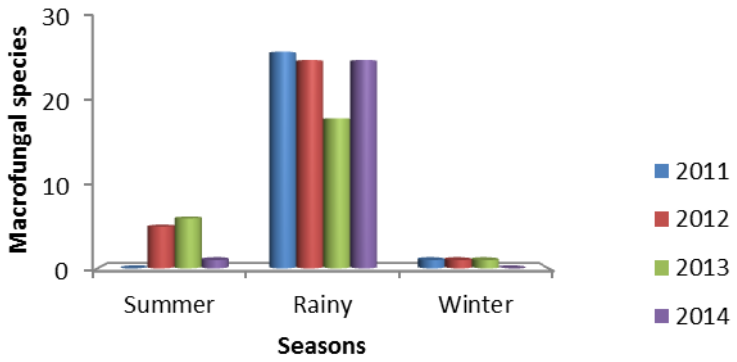

Fig. 4 – Distribution of macrofungal species in different seasons (2011-2014)

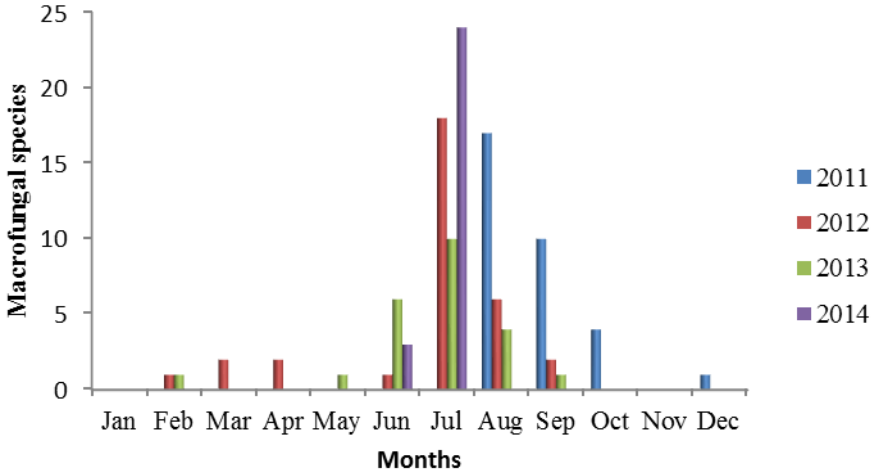

Fig. 5 – Distribution of macrofungal species in different months (2011-2014)

The diversity index is a mathematical representation of species diversity in a community. Diversity indices provide important information about rarity and commonness of species in a community. It takes in to account the number of species present (species richness), as well as the abundance of each species (evenness). Simpson's diversity index (1-D) is a simple method to measure species diversity in a community. The value of D ranges between 0 and 1. Greater the value of D greater is the diversity. Shannon diversity index is commonly used to characterize species diversity in a community. Macrofungi were collected from six different sites of Gorakhpur district to evaluate the macrofungi richness. Species diversity and species richness of macrofungi are shown in table 2. The area wise sampling for macrofungi shows that Sahjanwan tehsil contains highest number of species (53), followed by Sadar tehsil which contains 34 species, Khajni tehsil

Table 1 Diversity of macrofungi in Gorakhpur District

Voucher no.	Family	Macrofungi	Date of collection	Ecological habitat	Property
DDUNPL206	**Agaricaceae**	*Agaricus arvensis* Schaeffe.	23/9/11	Saprobic, on grassy area, in group	Excellent edible
DDUNPL207	**Agaricaceae**	*A. bernardii* Quèl.	11/7/12	Saprobic, on grassy area, in group	Excellent edible
DDUNPL208	**Agaricaceae**	*A. bitorquis* (Quèl) Sacc.	5/7/14	Saprobic, on manure in group	Edible
DDUNPL209	**Agaricaceae**	*A. impudicus* (Rea) Pilát	11/7/12	Saprobic, on humus in group	Edible
DDUNPL210	**Agaricaceae**	*A. langei* (F.H. Møller)	5/7/14	Saprobic, under mixed wood on soil in group	Edible
DDUNPL211	**Agaricaceae**	*A. silvaticus* Schaeff. ex.Secr.	20/7/12	Saprobic, on soil, solitary to in group	Edible
DDUNPL212	**Agaricaceae**	*A. silvicola* (Vittad.) Peck	11/8/11	Saprobic on decaying litters, solitary, scattered	Edible
DDUNPL213	**Agaricaceae**	*Chlorophyllum molybdites* (G. Mey.) Massee	3/7/13	Saprobic, growing gregariously in lawn and garden	Inedible
DDUNPL214	**Agaricaceae**	*C. rhacodes* (Vittad.) Vellinga	9/7/13	Saprobic, growing in group in gardens	Edible, choice
DDUNPL215	**Agaricaceae**	*Lepiota aspera* (Pers.) Quell.	1/10/11	Saprobic, on leaf litters in group	Edible
DDUNPL216	**Agaricaceae**	*L. atrodisca* Zeller	4/7/14	Saprobic, on leaf litters in group	Inedible
DDUNPL217	**Agaricaceae**	*L. castaneidisca* Murrill	23/9/11	Saprobic, under hardwood trees solitary to scattered	Inedible
DDUNPL218	**Agaricaceae**	*L. ignivolvata* Bousset & Joss.	23/08/11	Saprobic on soil	Inedible
DDUNPL219	**Agaricaceae**	*Leucoagaricus americanus* (Peck) Vellinga	5/7/13	Saprobic on humus, in group	Edible
DDUNPL220	**Agaricaceae**	*L. rubrotinctus* (Peck) Singer	29/9/11	Saprobic in group near *Bambusa arundinacea* culm	Inedible
DDUNPL221	**Agaricaceae**	*Leucocoprinus brebissonii* (Godey) Locq.	16/7/12	Saprobic on litter, solitary, scattered	Inedible
DDUNPL222	**Agaricaceae**	*L. cepestipes* (Sowerby) Pat.	24/2/13	Saprobic on humus rich soil, in group	Inedible
DDUNPL223	**Agaricaceae**	*Macrolepiota procera* (Scop.) Singer	23/7/12	Saprobic on decaying litter in group	Edible
DDUNPL204	**Amanitaceae**	*Amanita cokeri* E.-J. Gilbert & Kühner ex E.-J. Gilbert	20/7/12	Symbiotic with *Tectona grandis*, solitary, scattered	Inedible
DDUNPL205	**Amanitaceae**	*A. virosa* Fr.	18/8/11	Solitary on humus rich soil	Highly Poisonous

Table 1 (continued)

Voucher no.	Family	Macrofungi	Date of collection	Ecological habitat	Property
DDUNPL163	**Auriculariaceae**	*Auricularia auricula-judae* (Bull.) Quél	4/7/14	Parasitic on healthy tree (*Tecoma capensis*), in group	Edible
DDUNPL164	**Auriculariaceae**	*A. mesenterica* (Dicks.) Pers.	14/7/13	Saprobic, in group on decaying wood log	Inedible
DDUNPL255	**Bolbitiaceae**	*Bolbitius coprophilus* (Peck) Hongo	13/7/12	Coprophilous on compost, in group	Inedible
DDUNPL256	**Bolbitiaceae**	*B. vitellinus* (Pers.) Fr.	8/7/12	Coprophilous on goat dung, growing alone scattered	Poisonous
DDUNPL167	**Cantharellacea**	*Cantharellus minor* Peck	19/8/11	Saprobic, growing solitary or in groups under *Bambusa arundinacea*	Inedible
DDUNPL168	**Cantharellacea**	*C. subalbidus* Smith & Morse	31/8/12	Saprobic on decaying litter, in group	Edible
DDUNPL169	**Clavariaceae**	*Clavulinopsis laeticolor* (Berk. & M.A. Curtis) R.H. Petersen	16/7/12	Saprobic on decaying wood log, scattered, in group	Inedible
DDUNPL231	**Coprinaceae**	*Coprinus comatus* (O.F. Müll.) Pers.	7/7/12	Saprobic on manure, in group	Inedible
DDUNPL232	**Coprinaceae**	*C. disseminates* (Pers.:Fries) J.E. Lange	23/9/11	Saprobic on rotting tree branch, in group	Edible
DDUNPL233	**Coprinaceae**	*C. domesticus* (Bolton) Gray	4/7/12	Saprobic on decaying wood log, gregariously in small troops	Inedible
DDUNPL234	**Coprinaceae**	*C. lagopus* (Fr.) Fr.	7/7/12	Saprobic on decaying wood log, solitary to in group	Inedible
DDUNPL235	**Coprinaceae**	*C. pellucidus* P. Karst.	19/9/11	Saprobic on dead hardwood stump, in group	Inedible
DDUNPL236	**Coprinaceae**	*C. truncorum* (Scop.) Fr.	25/6/13	Saprobic on decaying wood log, in group	Inedible
DDUNPL171	**Fomitopsidaceae**	*Fomitopsis cajanderi* (P. Karst) Kotl. & Pouzar	6/9/13	Saprobic on dead wood, in group	Inedible
DDUNPL172	**Fomitopsidaceae**	*F. pinicola* (Sw.) P. Karst.	5/8/12	Saprobic on decaying tree (*Mangifera indica*), solitary to in group	Inedible
DDUNPL173	**Fomitopsidaceae**	*Laetiporus sulphurous* (Bull.) Murrill	26/9/11	Saprobic on cut wood log forming shelves	Edible
DDUNPL174	**Fomitopsidaceae**	*Postia stiptica* (Pers.) Jülich	5/7/14	Saprobic on decaying wood log, in group	Inedible

Table 1 (continued)

Voucher no.	Family	Macrofungi	Date of collection	Ecological habitat	Property
DDUNPL189	**Ganodermataceae**	*Ganoderma applanatum* (Pers.) Pat.	23/9/11	Parasitic on *Tectona grandis*, in group	Inedible
DDUNPL190	**Ganodermataceae**	*G. lucidum* (Curtis) P. Karst.	6/8/12	Saprobic on dead woods, solitary or in groups of 2-3	Edible
DDUNPL191	**Ganodermataceae**	*G. tsugae* Murrill	21/10/11	Saprobic on decaying tree, solitary	Inedible
DDUNPL271	**Geastraceae**	*Geastrum rufescens* Pers.	24/8/11	Saprobic on soil among leaf litters, solitary or in small groups of 2-3	Inedible
DDUNPL162	**Helotiaceae**	*Ascocoryne sarcoides* (Jacq.) J.W. Groves & D.E. Wilson	7/4/12	Parasitic on *Ficus racemosa*, gregarious, in group	Inedible
DDUNPL196	**Hygrophoraceae**	*Hygrophorus eburneus* (Bull.) Fr.	23/9/11	Saprobic on humus rich soil and on straw heap, solitary	Edible
DDUNPL192	**Hymenochaetaceae**	*Coltricia cinnamomea* (Jacq.) Murrill	18/10/11	Saprobic on humid soil, growing alone under hardwood	Inedible
DDUNPL193	**Hymenochaetaceae**	*Inonotus cuticularis* (Bull.) P. Karst.	9/2/12	Saprobic on decaying wood log forming shelves, in group	Inedible
DDUNPL194	**Hymenochaetaceae**	*I. hispidus* (Bull.) P. Karst.	6/7/14	Saprobic to parasitic on trees, either alone or forms shelves by joining with other caps	Inedible
DDUNPL195	**Hymenochaetaceae**	*I. radiatus* (Sowerby) P. Karst.	5/7/13	Saprobic on decaying wood log, in group	Inedible
DDUNPL257	**Inocybaceae**	*Inocybe dulcamara* (Pers.) P. Kumm.	4/7/14	Saprobic on decaying leaf litter, solitary to in group	Poisonous
DDUNPL258	**Inocybaceae**	*I. fastigiata* (Schaeff.) Quèl	3/7/14	Saprobic present on soil, solitary to in group	Poisonous
DDUNPL252	**Lentinaceae**	*Lentinus conatus* Berk.	4/7/14	Saprobic on decaying wood log, in group	Edible
DDUNPL253	**Lentinaceae**	*L. squarrosulus* Mont.	23/6/14	Saprobic on decaying wood log, in group	Edible
DDUNPL254	**Lentinaceae**	*L. tigrinus* (Bull.) Fr.	16/7/12	Saprobic, growing on rotting wood log	Inedible
DDUNPL268	**Lycoperdaceae**	*Bovista plumbea* Pers.	10/7/13	Saprobic, scattered in troops in short grasses	Edible
DDUNPL269	**Lycoperdaceae**	*B. pusilla* (Batsch) Pers.	5/7/14	Saprobic, scattered in troops in short grasses	Inedible

Table 1 (continued)

Voucher no.	Family	Macrofungi	Date of collection	Ecological habitat	Property
DDUNPL270	**Lycoperdaceae**	*Lycoperdon perlatum* Pers.	7/7/12	Saprobic, scattered along road side in group	Edible
DDUNPL259	**Lyophyllaceae**	*Calocybe gambosa* (Fr.) Donk	7/7/12	Symbiotic, in association with *Azadirachta indica* and *Ficus bengalensis*, in group	Excellent edible
DDUNPL260	**Lyophyllaceae**	*C.indica* Purkay. & A.Chandra	18/6/13	Saprobic on manure and husk residue, in group	Excellent edible
DDUNPL261	**Lyophyllaceae**	*Termitomyces heimii* K. Natarajan	14/7/12	Symbiotic in association with termites nest	Excellent edible
DDUNPL262	**Marasmiaceae**	*Marasmius curreyi* Berk. & Broome	24/8/11	Saprobic on rotting wood log, in group	Inedible
DDUNPL263	**Marasmiaceae**	*M. pulcherripes* Peck	5/7/14	Saprobic on litter, solitary to in group	Inedible
DDUNPL264	**Marasmiaceae**	*M. sicci* Murrill	29/8/13	Saprobic, on decaying wood log and leaf litter	Inedible
DDUNPL175	**Meripilaceae**	*Grifola frondosa* (Dicks.) Gray	25/8/11	Saprobic in association with decaying *Tectona grandis*	Edible
DDUNPL176	**Meruliaceae**	*Abortiporus biennis* (Bull.) Singer	24/6/13	Parasitic with living trees especially with *Bambusa arundinacea*, growing alone or in group forming shelves	Inedible
DDUNPL265	**Mycenaceae**	*Favolaschia pustulosa* (Jungh.) Kuntze	21/10/11	Saprobic on dead wood, gregarious	Inedible
DDUNPL266	**Phallaceae**	*Mutinus caninus* (Huds.) Fr.	5/7/14	Saprobic, growing alone or gregariously in garden	Inedible
DDUNPL267	**Phallaceae**	*Phallus duplicates* Bose	6/7/13	Saprobic, growing alone or gregariously in garden	Inedible
DDUNPL246	**Pleurotaceae**	*Pleurotus cystidiosus* O.K. Mill.	21/7/13	Parasitic on *Ficus benghalensis*, in group	Excellent edible
DDUNPL247	**Pleurotaceae**	*P. dryinus* (Pers.) P. Kumm.	22/8/13	Parasitic in association with *Dalbergia sissoo* tree, in group	Inedible
DDUNPL248	**Pleurotaceae**	*P. flabellatus* Sacc.	24/6/13	Saprobic on decaying wood, in group	Excellent edible
DDUNPL249	**Pleurotaceae**	*P. florida* (Mont.) Singer	25/8/12	Parasitic in association with *Ficus religiosa* in group forming shelves	Edible
DDUNPL250	**Pleurotaceae**	*P. ostreatus* (Jacq.) P. Kumm.	8/7/12	Parasitic on *Mangifera indica*, forming shelves	Excellent edible
DDUNPL224	**Pluteaceae**	*Pluteus luteovirens* Rea	4/7/14	Saprobic on leaf litters, in group	Inedible
DDUNPL225	**Pluteaceae**	*P. petasatus* (Fries) Gillet	19/8/11	Saprobic on wood debris, in group	Edible

Table 1 (continued)

Voucher no.	Family	Macrofungi	Date of collection	Ecological habitat	Property
DDUNPL226	**Pluteaceae**	*P. rimulosus* Kühner & Romagn.	7/7/14	Saprobic on rotting wood, solitary to in small groups	Inedible
DDUNPL227	**Pluteaceae**	*Volvariella bombycina* (Schaeff.) Singer	31/8/12	Parasitic in association with *Ficus bengalensis* tree, in group	Edible
DDUNPL228	**Pluteaceae**	*V. indica* M.K. Saini, N.J. Kaur & N.S. Atri	6/7/14	Saprobic abundant in garden, in group or scattered	Edible
DDUNPL229	**Pluteaceae**	*V. taylori* (Berk. & Broome) Singer	25/6/13	Saprobic, scattered in open field, solitary to in group	Edible
DDUNPL230	**Pluteaceae**	*V. volvacea* (Bull.) Singer	3/9/12	Saprobic on wheat straw or husk, in group	Excellent edible
DDUNPL177	**Polyporaceae**	*Fomes hemitephrus* (Berk.) Cooke	17/8/13	Parasitic on *Tectona grandis*, solitary	Inedible
DDUNPL178	**Polyporaceae**	*Funalia trogii* (Berk.) Bondartsev & Singer	5/7/14	Parasitic on *Artocarpus heterophyllus*, in group	Inedible
DDUNPL179	**Polyporaceae**	*Lenzites betulina* (L.) Fr.	4/4/12	Saprobic on deadwood, in group with overlapping cluster	Inedible
DDUNPL180	**Polyporaceae**	*L. sepiaria* (Wulfen) Fr.	13/7/12	Saprobic on decaying wood log, in group	Inedible
DDUNPL181	**Polyporaceae**	*Microporus xanthopus* (Fr.) Kuntze.	27/6/12	Saprobic on deadwood of hard wood, in group	Inedible
DDUNPL182	**Polyporaceae**	*Polyporus alveolaris* (DC.) Bondartsev & Singer	4/7/14	Saprobic on decaying logs, solitary to cluster	Inedible
DDUNPL183	**Polyporaceae**	*P. brumalis* (Pers.) Fr.	27/3/12	Saprobic on decaying wood	Inedible
DDUNPL184	**Polyporaceae**	*Pycnoporus cinnabarinus* (Jacq.) P. Karst.	27/3/12	Saprobic on dead wood, solitary to group	Inedible
DDUNPL185	**Polyporaceae**	*Trametes elegans* (Spreng.) Fr.	6/8/13	Saprobic on dead wood of hard woods, solitary or in groups	Inedible
DDUNPL186	**Polyporaceae**	*T. gibbosa* (Pers.) Fr.	5/12/11	Saprobic on decaying wood log, forming rosettes on top of cut stump	Inedible
DDUNPL187	**Polyporaceae**	*T. hirsutus* (Wulfen) Pat.	5/7/14	Saprobic on dead woods, in group	Inedible
DDUNPL188	**Polyporaceae**	*T. versicolor* (L.) Lloyd	13/09/12	Saprobic on decaying wood log, forming rosettes on top of cut stump	Inedible
DDUNPL237	**Psathyrellaceae**	*Coprinellus micaceus* (Bull.) Vilgalys, Hopple & Jacq. Johnson	19/8/11	Saprobic on humus rich soil, in group	Edible

Table 1 (continued)

Voucher no.	Family	Macrofungi	Date of collection	Ecological habitat	Property
DDUNPL238	**Psathyrellaceae**	*Coprinopsis atramentaria* (Bull.) Rehead, Vilgalys & Moncalvo	26/9/11	Saprobic, on rotting tree stump in group	Edible
DDUNPL239	**Psathyrellaceae**	*C. cothurnata* (Godey) Redhead	23/6/14	Coprophilous on animal dung	Inedible
DDUNPL240	**Psathyrellaceae**	*C. ephemeroides* (D.C.) G. Moreno	4/7/14	Saprobic on humus, solitary to in group	Inedible
DDUNPL241	**Psathyrellaceae**	*C. foetidella* (P.D. Orton) Atri, A. Kaur & M. Kaur	23/6/14	Coprophilous on animal dung	Inedible
DDUNPL242	**Psathyrellaceae**	*C. friesii* (Quèlet) P. Karsten	19/8/11	Saprobic on husk residue, solitary to in group	Inedible
DDUNPL243	**Psathyrellaceae**	*Panaeolus ater* (J.E. Lange) Kühner & Romagn.	11/8/11	Coprophilous on animal dung, in small group	Inedible
DDUNPL244	**Psathyrellaceae**	*P. papilionaeous* (Bull.) Quèlel	11/8/11	Coprophilus on cow dung manure, in group	Inedible
DDUNPL245	**Psathyrellaceae**	*Psathyrella automata* (Fr.) Quèl.	11/8/11	Saprobic on soil in grassland, solitary, scattered	Inedible
DDUNPL251	**Russulaceae**	*Russula sororia* Fr.	7/7/14	Saprobic on litter, solitary to in group	Edible
DDUNPL165	**Schizophyllaceae**	*Schizophyllum commune* Fries	11/8/11	Parasitic on *Mangifera indica* tree in group	Inedible
DDUNPL170	**Sparassidiaceae**	*Sparassis crispa* (Wulf) Fr.	18/8/11	Saprobic on decaying wood log, in group	Edible
DDUNPL166	**Stereaceae**	*Stereum hirsutum* (Wild.) Pers.	9/5/13	Saprobic on deadwood, gregarious	Inedible
DDUNPL197	**Tricholomataceae**	*Clitocybe inversa* (Scop.) Quèl.	18/8/11	Saprobic on litter, solitary or in groups	Inedible
DDUNPL198	**Tricholomataceae**	*C. vibecina* (Fr.) Quèl	23/9/11	Saprobic on decaying litter, scattered	Poisonous
DDUNPL199	**Tricholomataceae**	*Collybia fuscopurpurea* (Pers.) P. Kumm.	5/7/13	Saprobic on decaying litter, in group	Inedible
DDUNPL200	**Tricholomataceae**	*Lepista flaccid* (Sowerby) Pat.	4/7/14	Saprobic, abundant in mixed forest, in group	Inedible
DDUNPL201	**Tricholomataceae**	*L. luscina* (Fr.) Singer	31/8/12	Saprobic on humus, in group	Edible
DDUNPL202	**Tricholomataceae**	*Omphalina ericetorum* (Pers.) M. Lange	7/7/14	Saprobic on *Bambusa arundinacea* leaf litter, in small groups	Inedible

Table 1 (continued)

Voucher no.	Family	Macrofungi	Date of collection	Ecological habitat	Property
DDUNPL203	**Tricholomataceae**	*O. postii* (Fr.) Singer	5/7/14	Saprobic in grassy areas, solitary to in group	Inedible
DDUNPL161	**Tuberaceae**	*Tuber aestivum* Vitt.	10/7/13	Saprobic under broad leaf trees on calcareous soil	Excellent edible
DDUNPL158	**Xylariaceae**	*Daldinia concentric* (Bolton) Ces. & De Not.	29/8/11	Saprobic on decaying wood log, in group	Inedible
DDUNPL159	**Xylariaceae**	*Xylaria hypoxylon* (L.) Grev.	3/7/14	Saprobic on rotting wood, scattered	Inedible
DDUNPL160	**Xylariaceae**	*X. longiana* Rehm	27/6/13	Saprobic on decaying wood, in group	Inedible

Table 2 Shannon diversity index, Simpson diversity index, richness and evenness of macrofungi in Gorakhpur district (Tehsil wise)

	Bansgaon	Campierganj	Gola	Khajni	Sadar	Sahjanwan
No. of species (s)	5	4	6	12	34	53
Total no. of individuals (N)	55	105	30	140	314	644
Shannon diversity index (H)	1.13	0.16	1.43	2.08	3.04	3.61
Simpson diversity index (1-D)	0.64	0.29	0.74	0.85	0.94	0.97
Evenness (E)	0.82	0.49	0.62	0.87	0.86	0.90

contains 12 species, Gola tehsil contains 6 species, Bansgaon tehsil contain 5 species and Campierganj tehsil contains 4 species (Fig. 6). Sahjanwan tehsil shows the maximum diversity index. The Shannon's diversity index and Simpson's diversity index were found to be 3.61 and 0.97 respectively and evenness to be 0.90 in Sahjanwan tehsil. The highest number of species in Sahjanwan tehsil was contributed by the frequent collections made during the study period compared to other study sites in present study. The difference of the occurrence of macrofungi in the various localities in the study area also can be attributed to several factors such as rainfall, quantities of suitable substrate, damp forests with constant high air humidity and type of forest. The lower number of macrofungi recorded in this study could be because; only one to two collecting visits were made to each site. In fact complete knowledge of the fungi for any locality would require continuous observation and collection over many years (Bolhassan et al. 2012). Species diversity and occurrence increase with the increasing number of visits over a longer period.

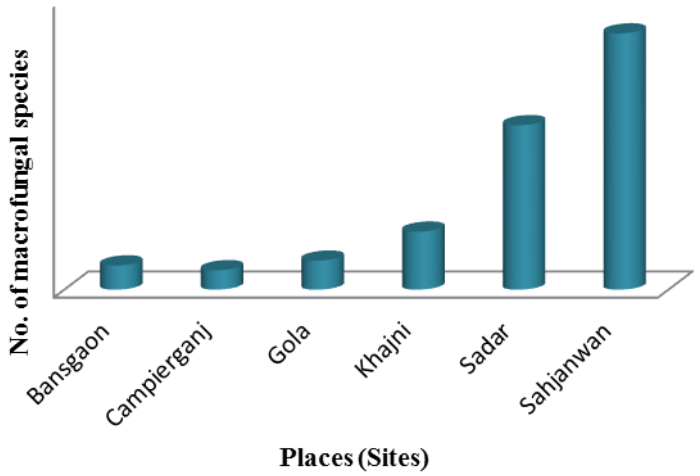

Fig. 6 – Number of macrofungi collected from different Tehsils of Gorakhpur district

Conclusion

North Eastern part of Uttar Pradesh with its varied topography, diverse vegetation and climatologic fluctuations can be successfully explored for the growth of macrofungi in wild habitat. In spite of the fact that this region is rich in resources of edible macrofungi, no planned effort has been made so far to collect and conserve them. There is vast scope of edible macrofungi which grow wild in forests and grasslands of this region. The moderate rainfall in this part supports a rich flora. These macrofungi can be widely used as food and medicine besides maintaining strength of ecosystem. Therefore it is very important to completely explore, document and conserve this natural wealth.

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