

**MACROFUNGAL BIODIVERSITY AND DISTRIBUTION IN THE
SAL (*SHOREA ROBUSTA*) FOREST**

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JUNE, 2016

**MACROFUNGAL BIODIVERSITY AND DISTRIBUTION IN THE
SAL (*SHOREA ROBUSTA*) FOREST**

Regi. No.: 10-03816

A Thesis

Submitted to the Department of Plant Pathology
Sher-e-Bangla Agricultural University, Dhaka
In partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

IN

PLANT PATHOLOGY

SEMESTER: JAN-JUNE 2016

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CERTIFICATE

*This is to certify that the thesis entitled "**MACROFUNGAL BIODIVERSITY AND DISTRIBUTION IN THE SAL (SHOREA ROBUSTA) FOREST, Sher-e-Bangla Agricultural University (SAU), Dhaka** in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS) IN PLANT PATHOLOGY** embodies the results of a piece of research work carried out by **SANJIDA RAHMAN** Registration no. 10-03816 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

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*DEDICATED TO
MY
BELOVED HUSBAND*

Acknowledgements

The author expresses to her special appreciation and thanks to her respectable Supervisor Professor **Dr. F.M Aminuzzaman**, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka-1207 for his constant supervision, valuable suggestions, continuous inspiration, constructive comments, and encouragement during the period of research work and guidance in the preparation of the thesis.

The author sincerely expresses her heartfelt gratitude and profound appreciation to her respected Co-Supervisor Professor **Dr. Md. Rafiqul Islam**, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka-1207 for his kind co-operation and encouragement to complete the thesis.

Moreover, the author sincerely expresses her thanks to PhD and MS fellows of the Department of Plant Pathology, her friends and batch mates for their contribution in the completion of her research work and also the author expresses her cordial thanks to departmental staffs.

Finally, the author likes to convey her heart-felt gratitude and deep love to her parents, relatives and all well-wishers for their blessings, moral support, prayer and sacrifices.

The Author

MACROFUNGAL BIODIVERSITY AND DISTRIBUTION IN THE SAL (*SHOREA ROBUSTA*) FOREST

ABSTRACT

A survey was conducted in Sal (*Shorea robusta*) forest regions of Bangladesh including Singra Sal Forest (Birganj), Madhupur Sal forest and Mithapukur Sal forest to study on biodiversity and distribution of macrofungi. In the Sal Forest 70-75% of the trees were Sal tree. A total 30 number of macrofungi samples were collected, and identified to 22 species belonging to 18 genera under 12 families were recorded during the survey. Among the recorded species, the highest frequency was 100% for *Ganoderma tsugae*, and *Ganoderma applanatum*, followed by 66.66% for *Agaricus* sp., *Amanita bisporigera*, *Macrolepiota procera*, *Clitocybe subconnexa*, *Coprinus disseminates* and *Termitomyces heimii*. The lowest frequency was 33.33% for the rest of the species (*Ganoderma lipsiense*, *Agaricus campestris*, *Psathyrella candolleana*, *Polyporus sulphurous*, *Trametes versicolor*, *Ganoderma lucidum*, *Schizophyllum commune*, *Lepiota humei*, *Leucocoprinus birnbaumii*, *Lepista sordida*, *Laetiporus sulphurus*, *Borofutus dhakanus*, *Craterellus cornucopioides*, *Volvariella gloiocephala*). The Highest density was 56.66% for *Coprinus disseminatus* followed by 53.33% for *Ganoderma lipsiense* and the lowest density was 3.33% for *Borofutus dhakanus* followed by 6.66% for *Agaricus campestris*.

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CHAPTER I

INTRODUCTION

The term 'macrofungi' is used mainly for the fruiting body which are belongs to the sub Division of Ascomycotina and Basidiomycotina. Some Mushrooms are edible and many of them are poisonous and also nonedible. The utilization of different fungi as food has definitely increased in the modern era with the achievement of more information about the edible and toxic mushrooms and development of cultivation methods of few mushrooms. About 50,000 valid species of fungi and about more than 2,000 species of major edible macrofungi about 80 have been developed experimentally and 25 established widely as food. However 20 varieties have been brought under commercial cultivation and 4 - 5 produced on large scale throughout the world (Chang and Miles, 1988). These are attractive due to their flavor, deliciousness and nutritive value.

Macrofungi are economically important since they serve as food, biocontrol agents, medicine, chemical producers of bioactive compounds used in the pharmaceutical and many other industries (Daurte *et al.*, 2006). Different type of edible mushrooms are grown on wider range for commercial use and many species of mushrooms grow widely in nature which has much medicinal and nutritional value.

Due to increased alertness of the pharmacological and as macrofungi have some nutritional values, there exists huge demand for it. The demand and consumers preference for different varieties of macrofungi among the people, utilization of mushroom are now widely introduced.

In around the world, scientists are now added more focus on the management of biomolecules from mushrooms for disease management and also for controlling different types of pest population, which is a challenging field of study. Even they play a vital role in ecosystem process. Mushrooms are seasonal fungi which form a greater share of the species richness in the forest ecosystem.

A macrofungi (or toadstool) is the fleshy spore bearing fruiting body of a fungus, which represents only a short reproductive stage in their life cycle

(Das,2010). They are being identified as one of the major food items from ancient times.Now a days macrofungi are considered as an ideal food item for general people.Mushroom can be grown well in above ground soil, on humus or on its food source.It is evident from the fossil records of the lower cretaceous period that the fungus Mushrooms have been existing on earth even long time before man appeared on earth. There are 14,000 Mushroom species has been reported, which is about 10% of the total estimated mushroom species on the earth.Mushrooms are mainly found in the rainy season.In Bangladesh about 80% rain falls during the rainy season. There are 800 species of Mushrooms with the potential of medicinal properties (Cheung, 2008).The Greeks and Romance treated Mushrooms as a unique kind of food source (Chang and Miles, 1988) and there is historical data of Mushroom utilization in primordial India (Chopra, 1933). Some mushrooms play as important source of revenue for rural communities in the developing countries and India (Wani *et al.*, 2010). Most of the *Ganoderma* sp. Contain medicinal properties. In China, for over 2,000 years, the Mushroom known as Reishi (*Ganoderma lucidum*) has been called “God’s Herb”. Also it was recognized by its Chinese name, Ling Zhi, Reishi’s reputation for being successful in treating a broad range of ailments moved.To date, about 1,200 species of fungi belonging to the order Agaricales, Russulales and Boletales are described in comparison to about 14,000 species of Mushrooms reported worldwide that contributes 10 percent of the global Mushroom flora.

Out of approximately 14,000 known species, 2,000 are harmless for human consumption and about 650 of these possess medicinal properties (Rai *et al.*,2005). Mushrooms alone are represented by about 41, 000 species, of which approximately 850 species are recorded from India (Deshmukh, 2004) mostly belonging to Agaricales, also known as gilled mushrooms (for their distinctive gills), or euagarics. The Agaricales has 33 extant families, 413 genera and over 13000 described species (Kirk *et al.*, 2008).

Mushrooms(edible) are considered as healthy food because of their mineral content is higher than that of meat or fish and most vegetables, apart from their nutritional value Mushrooms have potential medicinal benefits discussed by (Chan, 1981) and (Chang *et al.*, 1991). The wild Mushrooms are

comfortable sources of protein and have a minor amount of fat than commercial Mushrooms as described by (Barros *et al.*, 2008).

Mushrooms are not plants! Recently it has been revealed that they are more closely connected to animals. But at one time, Fungi including Mushrooms, were believed to be close relatives of plants so much of their nomenclatures (names for parts of the mushroom) are close to the names that used for plant parts. It is the fruit (like a mango) of the Mushroom which termed as "body" and "seeds" of fruit called spores of mushrooms. The body of the Mushroom is called mycelium and its individual parts are microscopic in nature. Since the body of the mushroom is usually dispersed over a relatively wider range of area, it is rarely noticed. In nature some species of mushrooms may have a body that spreads over hundreds of square miles from its origin.

Now a days, the researcher shows interest in Mushrooms and importance of Mushrooms are increasing tremendously not only in the ecosystem close to the dynamics but also in human diet, protein resources and health increases. Bangladesh is ranged between 3,280 and 4,780mm (129.1 and 188.2 inch) per year. The meandaily temperature ranged between 38°C and 41°C (100.4°F and 105.8°F) with relative humidity ranged from lower in March between 55% and 81% to higher in July between 94% and 100%. Winds are mostly from the north and northwest area in the monsoon, blowing gently at 1 to 3 kilometers per hour (0.6 to 1.9 mph). Thus, the northern region of Bangladesh was expected to furnish with diverse macro fungal population. The search for diverse macro fungal population in the country is important as the demand and consumer preference of Mushrooms for utilization among the people and farmers in the country is increasing day by day. Discovery of new bio-molecules from Mushrooms controlling human and crop diseases and pests is a challenging field of study.

Biodiversity, a contraction of "biological diversity," usually refers variety and unpredictability of life on Earth. Nilsson and Presson (1978) reported that, the color, shape and size of the fruiting body of mushroom can vary greatly. So that it is important to correctly identify the mushroom that is collected, so as to keep away from a poisonous species from the edible one. The knowledge on biodiversity at the community and species level is more important for

monitoring the effectiveness and effects of natural and artificial disturbances (Packham *et al.*, 2002).

The main objective of the present survey study was-

1. To collect and study the biodiversity, distribution and density of macrofungi in Sal forest regions of Bangladesh.
2. To identify the collected macrofungi up to the genus and species level on the basis of morphological study.

CHAPTER II

REVIEW OF LITERATURE

Das *et al.*, (2017) collected 32 species of macrofungi belonging to 21 genera from mangrove forest regions of Bangladesh. The major species of macrofungi collected from Mangrove forest were: *Agaricus campestris*, *Agaricus xanthodermus*, *Agaricus silvicola*, *Agaricus saungustus*, *Agaricus arvensis*, *Agaricus bitorquis*, *Marasmius* sp., *Marasmius siccus*, *Marasmius nigrodiscus*, *Volvariella hypopithys*, *Volvariella speciosa*, *Crepidotus alabamensis*, *Crepidotus applanatus*, *Coprinus silvaticus*, *Coprinus plicatilis*, *Marasmiellus albucorticis*. Agaricaceae, Marasmiaceae, Pluteaceae, Crepidotaceae and Mycenaceae are the major families. Their study was the first report on fleshy macrofungi in Mangrove forest of Bangladesh.

Rubina *et al.*, (2017) identified 20 species of macrofungi under 10 genera and 10 families from National Botanical Garden, Dhaka, where *Ganoderma* sp., *Lepiota* sp., *Daedaleopsis* sp., *Russula* sp., *Psathyrella* sp., *Lycoperdon* sp., *Crepidotus* sp., *Psilocybe* sp, *Flammulina* sp. and *Cantharellus* sp recorded as major genera. Among the species six species are edible, thirteen species are inedible where nine have medicinal value and one is of unknown uses. The maximum density of occurrence was exhibited by *Psilocybe cubensis* (45%) followed by *Lepiota* sp. (40%), *Ganoderma pfeifferi* (35%) and *Ganoderma lucidum* (25%).

Das and Aminuzzaman, (2016) identified 20 species of xylotrophic fungi belongs to 13 genera under 7 families such as Polyporaceae, Ganodermataceae, Hymenochaetaceae, Fomitopsidaceae, Xylariaceae, Steccherinaceae and Gloeophyllaceae. The predominant genera were *Ganoderma*, *Trametes* and *Inonotus*. The maximum frequency (75%) was recorded for *Daedaleopsis confragosa* and 50% for *Trametes elegans*, *Trametes conchifer*, *Polyporus sanguineus*, *Ganoderma curtisii* and *Irpex*

lacteus. The maximum density was 31.82% for *Pycnoporus sanguineus* which was found on the Sundari (*Heritiera fomes*) tree.

Rahaman *et al.* (2016) conducted an experiment on south western region of Bangladesh and collected 37 samples of mushroom. Among the total 37 sample, the highest 8 species were found under Agaricaceae family and 4 species were found under Pluteaceae family.

Rumainul *et al.* (2015) reported that, mushroom flora is an important element of the ecosystem and their biodiversity study for the tropical moist deciduous forest regions of Bangladesh has been mostly neglected and not recognized. They surveyed mushrooms flora in seven different areas of tropical moist deciduous forest region of Bangladesh. A total of fifty samples were collected and identified to fourteen genera and twenty four species. The predominant genera were *Ganoderma* sp., *Lepiota* sp., *Marasmius* sp. and *Collybia* sp. This is the first investigation on mushroom flora associated with tropical moist deciduous forest region of Bangladesh.

Rashid *et al.*, (2014) investigated on biodiversity and distribution of wild mushroom from southern region of Bangladesh and the maximum frequency was exhibited by *Ganoderma tsuage*, *Ganoderma applanatum*, *Amanita* sp. and *Agaricus silvicola* (18.75%) and also the maximum density was mentioned for *Coprinus silvaticus* (48.83%).

Chittaragi *et al.*, (2014) revealed that mushroom containing nutrient contents were low energy, healthy food and may also be used as a protein supplementary diet. They also mentioned that the mushroom is a valuable source of healthy food, which is low in calories, and rich in carbohydrates, essential amino acids, fibre, important vitamins and minerals.

Kauret *et al.*, (2014) reported light spored agarics from India which were not earlier known from India. They found three light spored agarics belongs to the two genera namely *Lepiota* (*Lepiotahumei*, *Lepiota brunneoincarnata*) and *Chlorophyllum* (*Chlorophyllum sphaerosporum*).

Vyas *et al.*, (2014) carried out an experiment on the period of July 2011 to July 2013, in the Patharia forest where wild mushrooms were collected. They identified 18 mushroom species belonging to 12 families viz. *Lepisa nuda*, *Pleurotus cornucopiae*, *Vascellum pretense*, *Lycoperdon pyriform*, *Coniphora puteana*, *Tyromyces lacteus*, *Clitocybe geotrappa*, *Ganoderma tsugae*, *Microglossum virde*, *Panaeolus sphinctrinus*, *Fomes fomentarius*, *Lenzites betulina*, *Hypholoma elongatum*, *Pholita highlandensis*, *Serpula lacrymans*, *Tremella mesenterica*, *Collybia butyracea* and *Omphalina ericetorum*. Among them some are edible similar to *L. nuda* and *Clitopilus prunulus* which are used to prepare native medicines using conventional techniques. Patharia forest which is dry and mixed type deciduous forest, it is dominated by *Tectona grandis*, *Acacia* sp., *Butea monosperma* and ground flora consisting of *Biophytum sensitivum*, *Cynodon dactylon*, *Lanata camara* etc.

Alemu, (2013) described the fungi associated with soil and responsible for wood decaying could lead to the development of more environmentally food supply systems and wood rot fungi can be used for enzyme production in industrial purpose. Ascomycota and Basidiomycota phylum were commonly associated with dirt soil and wood, these fungi can be used as food source, therapeutic agent and other may have a potential for Biotechnological purpose for enzyme production in industrial level.

Chandulal *et al.* (2013) collected 17 species where two different classes namely, Gastromycetes and Hymenomycetes were found. The identified species were - *Daldinia concentrica* [(Xylariaceae) (cramp ball)], *Lycoperdon pyriforme* [(Lycoperdaceae, edible) (wood or stump puff ball)], *Scleroderma citrinum* (Sclerodermataceae, edible); *Cantharellus umbonatus*, *Coriolus versicolor* (Polyporaceae, inedible), *Schizophyllum commune* (Schizophyllaceae, inedible) (the split gill), *Ganoderma lucidum* (Ganodermataceae), *Ganoderma applanatum* (ganodermataceae), *Laetiporus sulphureus* (Polyporaceae, edible), *Lepiota organensis*, *Collybia butyracea*, *Lentineullus cochleatus* (Auriscalpinaceae, edible), *Galerina unicolor* (Hymenogatraceae), *Citocybe flaccida* (Trichomataceae, edible), *Oudemansiella redicata* (Physalacriaceae, edible), *Hygrophorus eburnes*

(Hygrophoraceae, edible) and *Agaricus campestris* (Agaricaceae, edible). They also mentioned that the research proved that there belongs distinct biodiversity in mushroom population in Navsari(India).

Deepika *et al.* (2013) collected the genus *Cantharellus* (Cantharellaceae) from the northwestern Himalayas, India where they used LSU (nuclear ribosomal large subunit sequences) to find out the Phylogenetic relationship and species limits. Thirteen species were recognized by their investigation. They are *Cantharellus appalachiensis*, *Cantharellus cibarius*, *Cantharellus lateritius*, *Cantharellus miniatescens*, *Cantharellus minor*, *Cantharellus pseudoformosus*, *Cantharellus applanatus*, *Cantharellus elongatipes*, *Cantharellus fibrillosus*, *Cantharellus himalayensis*, *Cantharellus indicus*, *Cantharellus natarajanii*, *Cantharellus umbonatus*.

Bankole *et al.* (2012) recorded sixteen mushrooms including *Agaricus campestris*, *Coprinus comatus*, *Daldinia concentrica*, *Ganoderma adpersum*, *Ganoderma applanatum*, *Ganoderma lucidum*, *Mycena haematopus*, *Mycena* sp., *Pleurotus ostreatus*, *Pleurotus tuber-regium*, *Polyporus* sp., *Polyporus squamosus*, *Polyporus sulphureus*, *Trametes versicolor*, *Xylaria polymorpha*, and *Xylaria* sp. In Lagos State, Nigeria. They investigated on biodiversity of mushrooms in using modern biotechnological method of DNA sequence analyses.

Pushpa and Purushothama (2012) supervised the biodiversity of mushrooms of Bangalore where a total number of 90 species in 48 genera belonging to 19 families in 5 orders were found, where 28 species were found to be recorded for the first time in India. Among the collected species *Coprinus disseminates* followed by *Coprinus fibrillosis* and *Schizophyllum commune* was found to be plentiful in amount.

Dwivedi *et al.* (2012) conducted a field survey on macro fungi in semi evergreen and moist deciduous forest of Amarkantak on the basis of taxonomy and diversity where more than 50 samples were collected. Genera like *Agaricus*, *Aminita*, *Nyctalis*, *Russula*, *Boletus*, *Macrolapiota*, *Ganoderma*, *Termitomyces* were identified during that survey.

Srivastava *et al.* (2011) identified four species of *Termitomyces* from the Gorakhpur forest region to determine the genetic diversity among these four samples. Morphological characterization, phenotypical appearance were considered during the study. Four species naming *Termitomyces heimii*, *Termitomyces clypeatus*, *Termitomyces mammiformis* and *Termitomyces microcarpus* were categorized by following morphological character i.e., shape of perforatorium, stipe length(cm), pileus length, margin of fruit body, colour of fruit body, gills, flesh, annulus, pseudorrhiza and spore print etc.

Hosen and Ge (2011) first time reported an attractive agaric, *Clarkeinda trachodes* from Bangladesh. The genus is characterized by the presence of a fawn colored pellicle on the central pileus surface, a stripe with a superior annulus and basal volva, which is currently known only from south and Southeast Asia.

Ram *et al.*, (2010) investigated various edible fleshy mushroom fungi from different localities of the Eastern Uttar Pradesh forest where the collected edible fleshy fungi (*Agaricus bisporus*, *Armanillaria ponderosa*, *Hypomyces lactiflies*, *Ganoderma sp.*) were studied for their macroscopic characteristic and other phenotypic parameter.

Hanlon and Harrington (2010) surveyed of Agaricomycete species from the Republic of Ireland to study the diversity and distribution of mushroom and the records are verified with similar records from Northern Ireland, England, Scotland and Wales. They found that the number of Agaricomycete species were recorded from Ireland is much lower than in the other countries. The ROI has 100, 700, 1300 and 2200 fewer species than in Northern Ireland, Wales, Scotland and England respectively. Agaricomycete diversity indicated that 25 out of 26 countries have less than half of their likely Agaricomycete diversity.

Karwa and Rai (2010) visited Melghat forest in Central India and collected wild edible fungi from the forest. A total of 153 species of mushrooms were observed where dominating species belong to genera were *Agaricus*, *Pleurotus*, *Termitomyces*, *Cantharellus*, *Ganoderma*, *Auricularia*, *Schizophyllum*, *Morchella* etc.

Celiket *et al.* (2009) conducted an experiment on Benefit or cost analysis of mushroom production in developing countries to find out the diversification of income in those countries and they concluded that the cost of 1 KG mushroom as an average of business was USD 1.36 that its average sales price was USD 1.54.

Antonin and Buyck (2006) identified twenty six samples which represents 19 taxa of the genus *Marasmius* from Madagascar, Mauritius and Réunion. The species described are: *Marasmius andasibensis*, *Marasmius andasibensis* var. *obscurostipitatus*, *M. brunneoaurantiacus* and *M. curreyi* var. *bicystidiatus*.

Niazi *et al.*,(2006) found that *Russula brevipes* was associated with *Pinus wallichiana* in Himalayan Moist Temperate Forests of Pakistan and the biodiversity of mushrooms, *Russula brevipes* have also been cited and illustrated where the fungus were new report for Pakistan.

Agrahar and Subbuakshmi (2005) conducted an experiment on Meghalaya mushrooms. Meghalaya (25°47'N and 26°10'N latitude and 89°45'E and 92°47'E longitude) stated between the two plains of Assam in the north and Bangladesh in south. It has a wide variation in altitude, topography and agro climate. The region is generally contained large amount of forest. These forests were plentiful with macro fungi which are found on the soil, twigs and branches, humus etc. They conducted a survey to identify the edible fungi from this forest region along with their morphology, distribution, habitat and edibility.

Manzi *et al.*,(2001) tested fresh and processed mushrooms where they observed that the botanical variety, processing and cooking are all effective parameters of mushroom composition. They also included that the dried mushrooms (*Boletus* group) show the highest nutritional value after completing cooking process, it also includes Dietary fiber, chitin and beta glucans at variable amounts. Chitin level ranges from 0.3 to 3.9g/100g, while beta glucans which are small in amount *in Agaricus*, range from 139 to 666

mg/100g in *Pleurotus ostreatus* and *Boletus* group. On an average, a serving (100 g) of mushroom will supply 9% to 40% of dietary fiber.

Chang *et al.*,(1981) stated that the Fruiting bodies of mushroom contained 4.30-50.7% of carbohydrate,82.5-92.2% of water, 26.6-34.1% of protein and 1.1-8.0% of fat.

Nilsson and Presson (1978) explained that proper identification of mushrooms are necessary to compare the specimen from the toxic specimen,proper identification could be done according to the color, shape and size of the fruiting body of fleshy fungi. They indicated mushroom species as the indicators of the forest life system.

CHAPTER III
MATERIALS AND METHODS

3.1. Collection site

The survey was conducted in Sal Forest region of Bangladesh (Figure-1). Collection site was three Upazila namely Mithapukur, Birganj, Madhupur of Rangpur, Dinajpur and Tangail districts of Sal Forest region of Bangladesh. According to the National Mapping Organization of Bangladesh, Mithapukur is located at 25°32.5'N (Latitude), 89°17'E (Longitude); Birganj is located at 26°0'0"N (Latitude), 88°35'0"E (Longitude) and tangail is located at 24°37'0.12"N (Latitude), 90°1'30"E (Longitude). Collection site was Sal forest region where Sal tree (*Shorea robusta*) is the dominant tree species.

3.2. Survey areas

Table 1: Survey areas of Sal forest regions of Bangladesh

| SI No | Name of District | Surveyed Upazila | |
|--|------------------|--------------------------|-------------------|
| | | Name of surveyed Upazila | Number of Upazila |
| 1. | Rangpur | Mithapukur | 1 |
| 2. | Dinajpur | Birganj | 1 |
| 3. | Tangail | Madhupur | 1 |
| Total Survey areas =(District 3, Upazila 3) | | | |

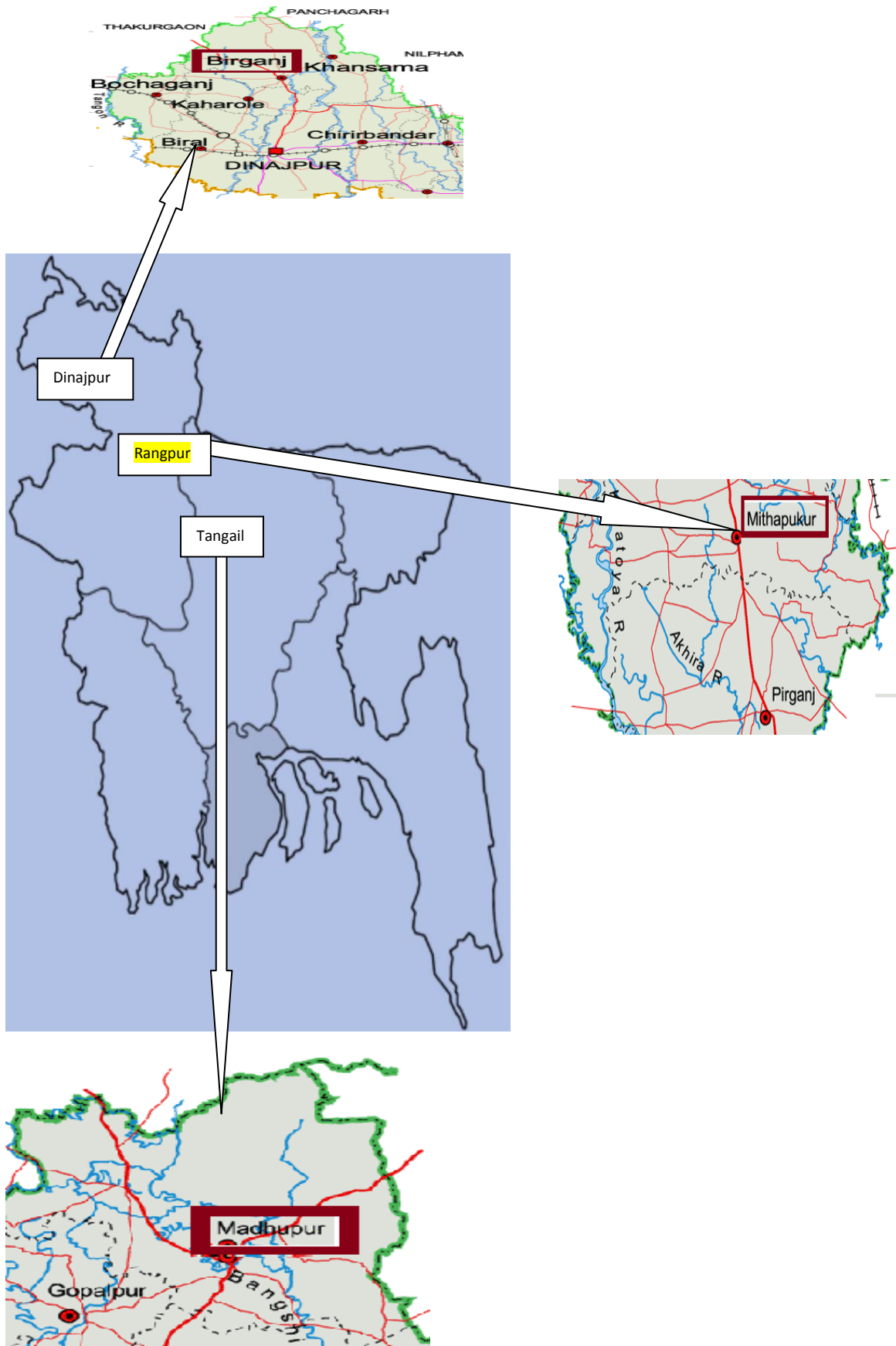


Figure 1: Survey location of Macrofungi in Sal (*SHOREA ROBUSTA*) forest region of Bangladesh.

3.3. Time of Collection

Collection of macrofungi (Mushrooms) was done in the above selected area during July to October 2016 and March to April 2017.

3.4. Source of data and sampling procedure

A systematic sampling procedure was used in this baseline survey. Three Upazila belong to three districts of Sal forest regions of Bangladesh were selected for conducting survey analysis on mushrooms biodiversity, distribution, habitat and morphology. A pre-designed collection procedure and data analysis procedure were used to collect information on level of knowledge on biodiversity, habitat and morphology of mushrooms in selected regions of Bangladesh.

3.5. Collection of macrofungi

Systematic and periodical survey of Mushroom were done in the Sal forest regions of Bangladesh. The survey of Mushroom were performed on the basis of time of collection, weather condition, location of observation, sampling procedure etc. The collection was made according to the method of Hailing (1996). Necessary materials and equipments such as isolation kit, slants, zipper bag, typed data sheet, digital camera for photography, digging equipment, heat convector card board were arranged and collection of samples were generally made during day time and field characteristics of mushrooms were recorded in the prepared data sheet which was prepared following Molina *et al.*, (1995) where field notes, date of collection, source, morphology, locality, ecology, microscopic, macroscopic, culture characteristics and specimen number on tag was included. Soft mushrooms were collected carefully by using forceps/free hand. The photograph was taken in their natural habitat. Photographs were taken by means of a Sony Cyber-shot Digital Camera with power of 14.2 megapixels. Each sample was wrapped in the zipper bag envelop along with necessary information about the sample. Then the samples were brought to the laboratory for morphological study.

3.6. Observation of macrofungi during collection

After collection of the samples data were recorded on the basis of following parameters for recognition of macrofungi samples. The parameters are color, size, spore bearing surface under cap, pileus (cap of the carpophore, color, surface characters and zonation, pileus margin, pileus cuticle, pileus context), Texture of the fruiting body, Flesh odor, Lamellae, Forking pattern, Locality, Habitat, Type of soil, Factors affecting their distribution, Forest type, Type of association, Size of the fructification, Umbo, Gill color, gill edges, gill attachment, gill spacing, stipe length, width, color, shape, type of veil, annulus (Position) and volva following (Srivastava *et al.*, 2010.)

3.7. Experimental site

The experiment was conducted in the Laboratory, Department of Plant Pathology at Sher-e-Bangla Agricultural University, Dhaka.

3.8. Identification of wild macrofungi

The collected mushroom specimens were identified according to the documents published by Arora (1986) and Singer (1986). For further microscopic studies, The spores of collected mushrooms were placed on slide by using glycerine or cotton blue for measurement purpose. The spore diameter and the photograph of spores were counted by using the Motic Microscope (Motic images plus 2.0) with the magnification of 40X. Adequate amount of mushroom samples (generally one mature and one immature) were sampled for each number of collection to gather exact information about the fungi. Through comparing recorded characteristics the mushrooms were identified following Dickinson and John (1982), Jorden (2000), Pegler and Spooner (1997).

3.9. Processing of macrofungi

After collection of macrofungi samples necessary photographs should be taken in different angle to recognize its natural color. Mushrooms were dried and processed following (Kim, 2004). Proper processing of mushrooms should be followed as mushrooms are very much fleshy in nature and it could be deteriorate easily by the attack of enzymes and microorganisms. So, it should be preserved properly. First of all, harvested macrofungi was cleaned by using clean cloth or cotton (fleshy mushroom) or washed by water for removing dirt and waste material (woody mushroom) from the sample.

3.10. Drying

Each and every samples were dried with electrical air flow drier with 1000 voltage, which easily remove moisture from collected macrofungi within three to seven hours with regular interval basis power supply (15 minutes switch off and 30 minutes switching) depending on the structure and texture of the species (Kim, 2004).

3.11. Storage

Zip-lock type polybags were used to store the dried specimen during the survey. Silica gel was used at the rate of 10% of dry basis during the storage period (Kim, 2004). It helps to remove extra moisture from the sample.

3.12. Morphology and microscopic characterization in the laboratory

The basidiocarps were rehydrated by soaking in water for few minutes before analyzing the morphology of collected samples. Color, shape, and presence of hymenia were estimated by eye observation while texture was determined by feeling the back and top surfaces using fingers.

Most of the morphological data were filed during collection period that is when the mushroom was in fresh form. For microscopic characters, permanent glass slides were made from rehydrated basidiocarps with the aid

of a sharp blade. Basidiocarps were immersed in cotton blue stain and glycerin and placed on glass slides and covered with cover slips and spore size was measured using Motic Images plus 2.0 software and Motic microscope (40X) to observe the slides by following Svrcek,(2000).

Final identification and classification were done by comparing recorded characteristics of mushrooms with the color dictionary of mushroom given by Dickinson and John (1982), the mushroom guide and identifier by Jorden (2000) and the mushroom identifier by Pegler and Spooner (1997).

3.13. Habitat, distribution and diversity analysis

The surrounding environment temperature, soil pH, moisture condition, vegetation were associated with the collection as the specimens were found involved to various substrata. Soil pH, soil moisture were measured by pH meter and air temperature by thermometer during collection period. The distribution of the mushrooms in the surveyed location were recorded. The frequency and density of different species has been determined by the following formulas (Zoberi, 1973).

$$(\%) \text{ Freq. of fungal species} = \frac{\text{Number of site in which the species is present}}{\text{Total number of site}} \times 100$$

$$(\%) \text{ Density} = \frac{\text{Total number of individual of a particular species}}{\text{Total number of species}} \times 100$$

CHAPTER IV

RESULTS AND DISCUSSION

This investigation was carried out at Sal Forest Region of Bangladesh (Tangail, Dinajpur, Rangpur) to record the morphology, diversity and distribution of collected and Identified macrofungi. A total of 22 macrofungi species were described below:

4.1 Biodiversity, distribution and morphological charecterization of *Agaricus sp.*

4.1.1 *Agaricus campestris*

Common name: Field mushroom or meadow mushroom.

Family: Agaricaceae.

Morphology of *Agaricus campestris*

Average size of fructification was 6.5×8.3 cm. The color of pileus (cap) was whitish. The shape of cap was Convex to broadly convex and smooth. Fleshy white Color scale was found on the cap.

Hymenophores were absent beneath the cap. Regular shaped gills (lamellae) were present under side the cap. Gills were free from the stem. It appears in pink to brown and then dark chocolate brown in maturity. The color of gills was chocolaty brown. Color of stipe was whitish. The average length and width of stipe was 3.8 cm and 1.9 cm respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, rough and irregular shaped and average spore size was 6.2×3.8 μm (Plate-1).

Habitat of *Agaricus campestris*

The macrofungi was found on the soil beside sal tree. The soil was found mixed with yellowish red sandy clay and moist in nature. Average Relative Humidity was 82%. Average recorded temperature was 23⁰C.

Biodiversity of *Agaricus campestris*

Agaricus campestris was found in Madhupur upazila of Tangail district. A total two number of mushrooms of *Agaricus campestris* were found during collection. The frequency of its presence was 33% and the density was 6.66%.

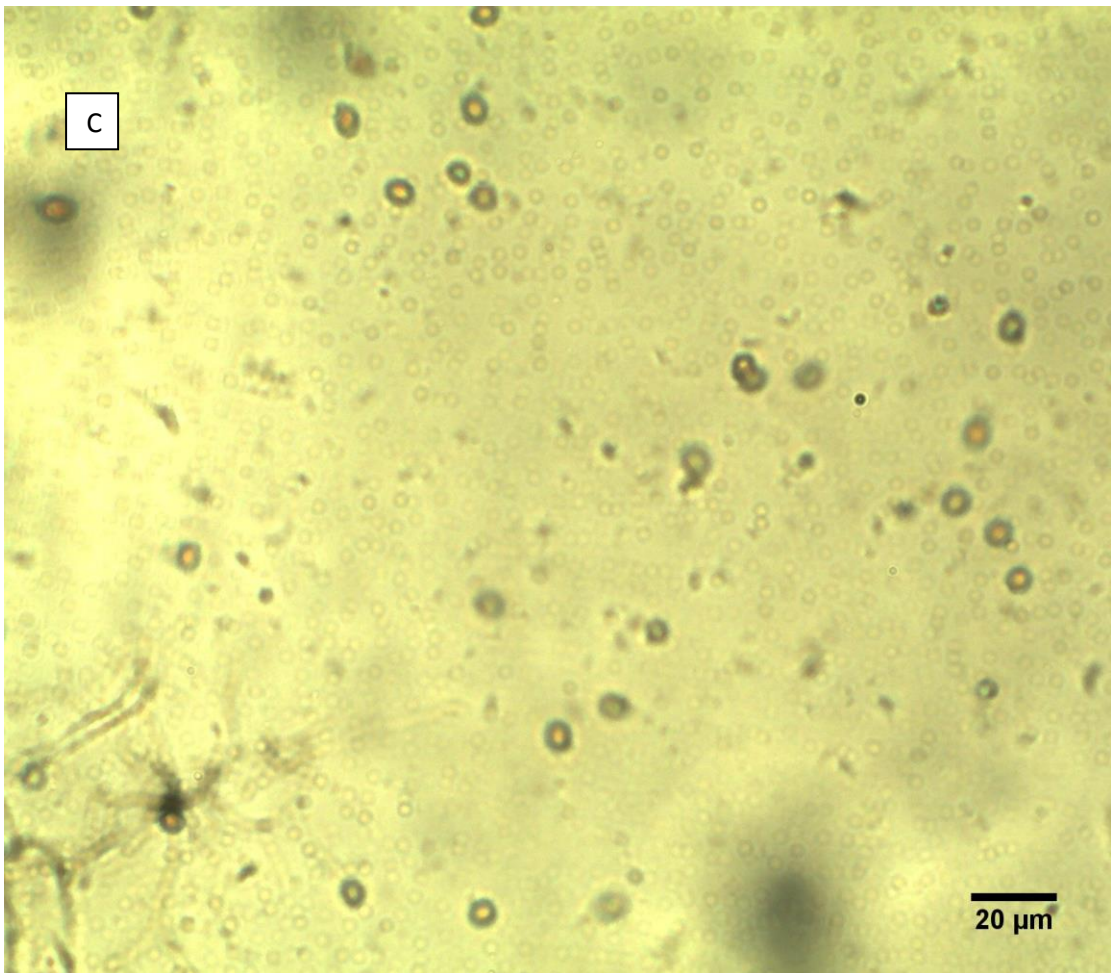
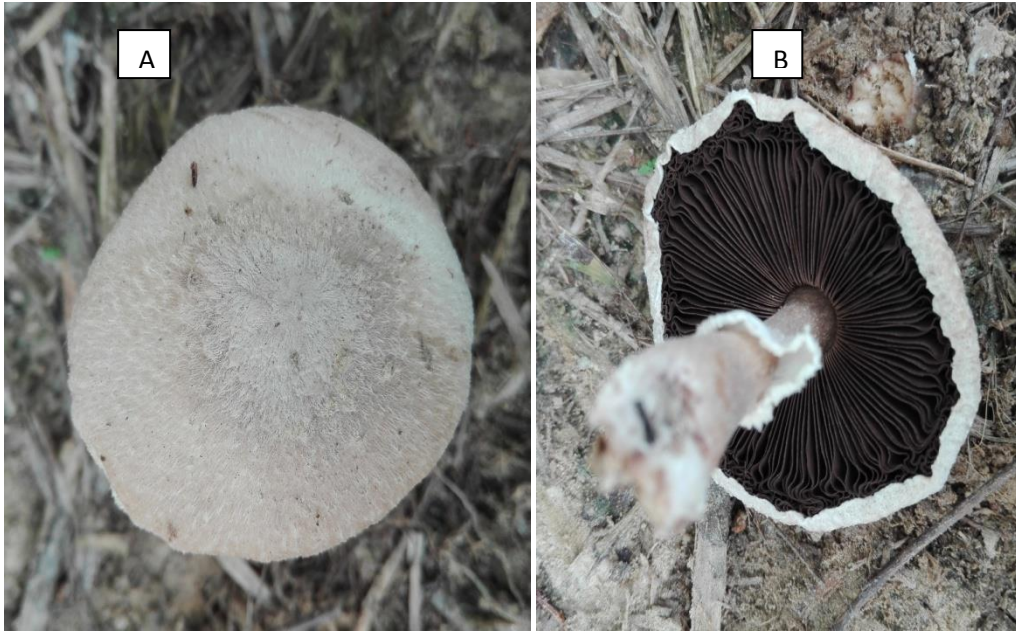


PLATE 1. *Agaricus campestris*; Mature fruiting body, Cap (A), Gills (B), Spores (C)

4.1.2 *Agaricus* sp.

Family: Agaricaceae.

Morphology of *Agaricus* sp.

The color of pileus (cap) was whitish. The shape of cap was Convex to broadly convex and smooth. Fleshy white Color scale was found on the cap. Hymenophores were absent beneath the cap. Regular shaped gills (lamellae) were present underside the cap. Gills were free from the stem. It appears in white in color. Color of stipe was whitish. The average length and width of stipe was 2.7 cm and 1.3 cm respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, rough and irregular shaped and average spore size was 5.2×2.9 μm (Plate-2).

Habitat of *Agaricus* sp.

The mushroom was found on the soil beside sal tree. The soil was loamy and moist in nature. Average Relative Humidity was 82%. Average recorded temperature was 26°C.

Biodiversity of *Agaricus* sp.

Agaricus sp. was found in Mithapukur and Madhupur upazila of Rangpur and Tangail district respectively. A total six number of *Agaricus* sp. samples were found during the collection. The frequency of its presence was 66.66% and the density was 20%.

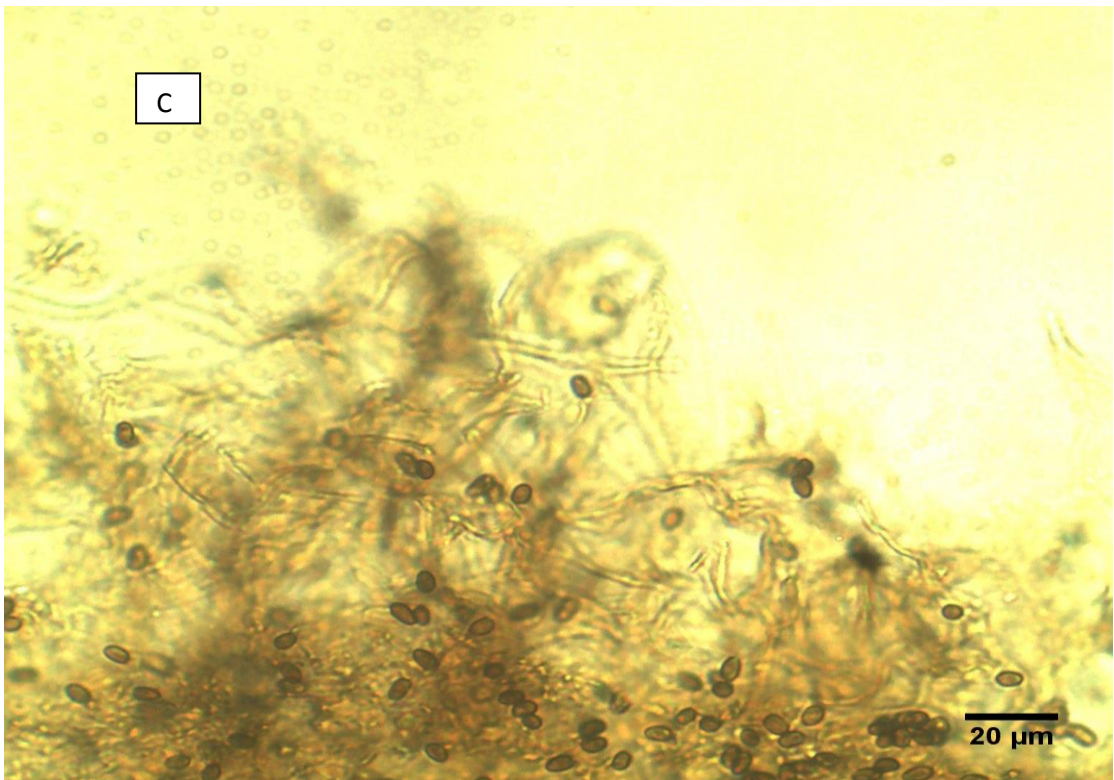
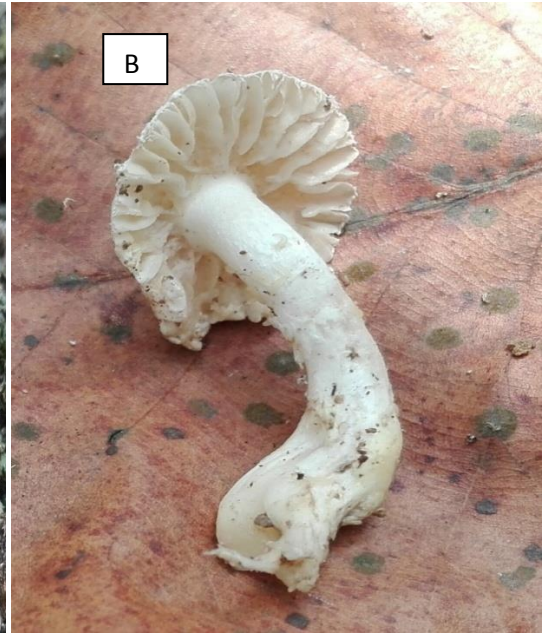


PLATE 2. *Agaricus* sp; Mature fruiting body, Cap (A), Gills (B), Spores (C).

4.2 Biodiversity, distribution and morphological characterization of *Amanita* sp.

4.2.1 *Amanita bisporigera*

Common name: The destroying angle.

Family: Amanitaceae.

Morphology of *Amanita bisporigera*

Amanita bisporigera was found in soil and the size of fructification was 2-3.5×3-4 cm. The color of pileus (cap) was white. The shape of cap was ovate. The cap edge was flat or grooved. Whitish scale was found on the cap. Beneath the cap hymenophores were present. Regular shaped pores were present underside of the cap of *Amanita bisporigera*. The color of pores was creamy white. Color of stipe was whitish. The length and width of stipe was 2-3 cm and 1-1.5 cm, respectively. Ring or anal was absent on the stipe and volva was present on the lower part of the stipe in *Amanita bisporigera*. Spore color was brown, spore shape was ellipsoid, single walled and spore size was 7-8×6-6.5 μm (Plate 03).

Habitat of *Amanita bisporigera*

Amanita bisporigera were found on the soil near sal tree. Relative Humidity was 78% and the recorded soil pH for *Amanita bisporigera* was 6.5. Soil type was loam. The average recorded temperature was 29⁰C.

Biodiversity of *Amanita bisporigera*

Amanita bisporigera was found in Mithapukur and Madhupur upazila of Rangpur and Tangail District. A total ten number of mushrooms of *Amanita bisporigera* were found during the collection. The frequency of its presence was 66.66% and the density was 33.33%.



PLATE 3. *Amanita bisporigera*; Mature fruiting body, Cap (A), Pores (B), Spores (C).

4.3 Biodiversity, distribution and morphological characterization of *Ganoderma* sp.

4.3.1 *Ganoderma tsugae*

Common name: Reishi mushroom.

Family: Ganodermataceae.

Morphology of *Ganoderma tsugae*

Fructification size was 4-5×2-3 cm. The color of pileus (cap) was redish. The shape of cap was hard and flat. The cap edge was undulating. Scale was not found on the cap. Beneath the cap hymenophores were not present. Regular shaped gills (lamellae) were not present underside of the cap of *Ganoderma tsugae*. Pore color of the macrofungi was whitish with red margin. Pseudostem present under the cap. Ring and volva was absent. Basidium color was brown, spore was oval in shape, size of spore was 5.8-6.5µm (Plate 4).

Habitat of *Ganoderma tsugae*

The mushrooms were found on the bark of Sal tree (*Shorea robusta*). Average Relative Humidity was 79%. Average soil pH was 6 to 6.5. Soil type was loamy. Average recorded temperature was 29°C for *Ganoderma tsugae*.

Biodiversity of *Ganoderma tsugae*

Ganoderma tsugae was found in Birganj (Singra forest), Madhupur and Mithapukur upazila of Dinajpur, Tangailand Rangpur District. A total 10 number of *Ganoderma tsugae* sample were found during the collection. The frequency of its presence was 100% and the density was 33.33%.

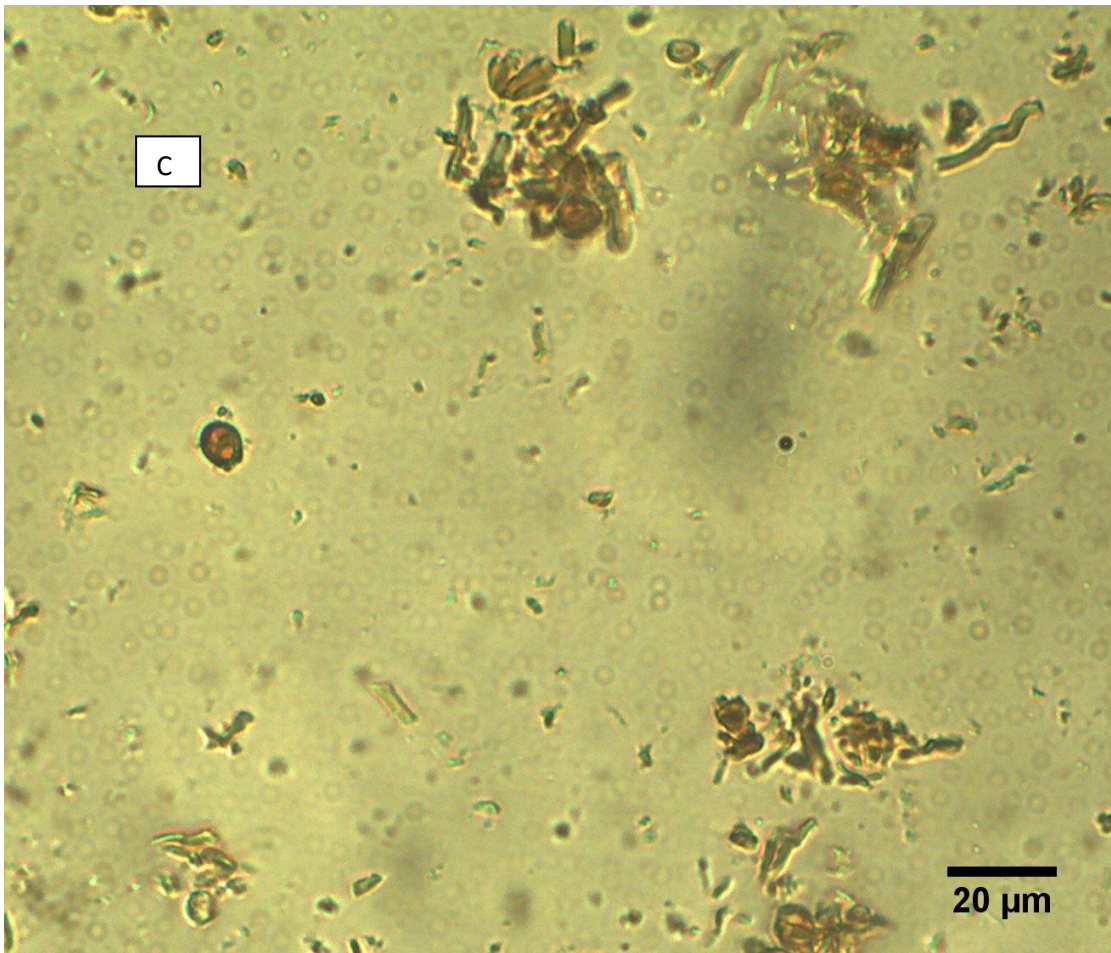
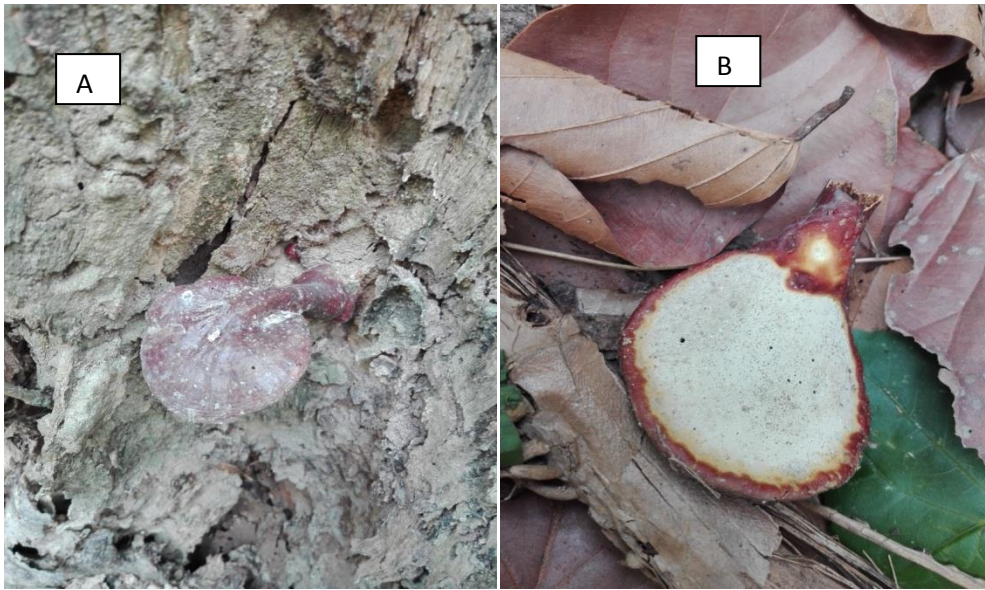


PLATE 4. *Ganoderma tsugae*; Mature fruiting body, Cap (A), Pores (B), Spores (C).

4.3.2 *Ganoderma applanatum*

Common name: Lingzhi or Reishi mushroom.

Family: Ganodermataceae.

Morphology of *Ganoderma applanatum*

Fructification size was 8-10×4-6 cm. The color of pileus (cap) was bluish with brown margin. The shape of cap was hard and flat. The cap edge was undulating. Scale was not found on the cap. Beneath the cap hymenophores were not present. Regular shaped gills (lamellae) were not present underside of the cap of *Ganoderma applanatum*. Pseudostem present under the cap. Ring and volva was absent. The color of spore was reddish and structure was single walled, smooth, oval shaped and spore size was 8.5-7×5-6 μm (Plate 5).

Habitat of *Ganoderma applanatum*

The macrofungi were found on the bark of Sal tree (*Shorea robusta*). Average relative humidity was 79%, average soil pH was 6 to 6.5. Soil type was loamy type. Average recorded temperature was 29⁰C for *Ganoderma applanatum*.

Biodiversity of *Ganoderma applanatum*

Ganoderma applanatum was found in Birganj (Singra forest), Madhupur, and Mithapukurupazila of Dinajpur, Tangail and Rangpur District. A total 15 number of mushrooms of *Ganoderma applanatum* were found during collection. The frequency of its presence was 100% and the density was 50%.

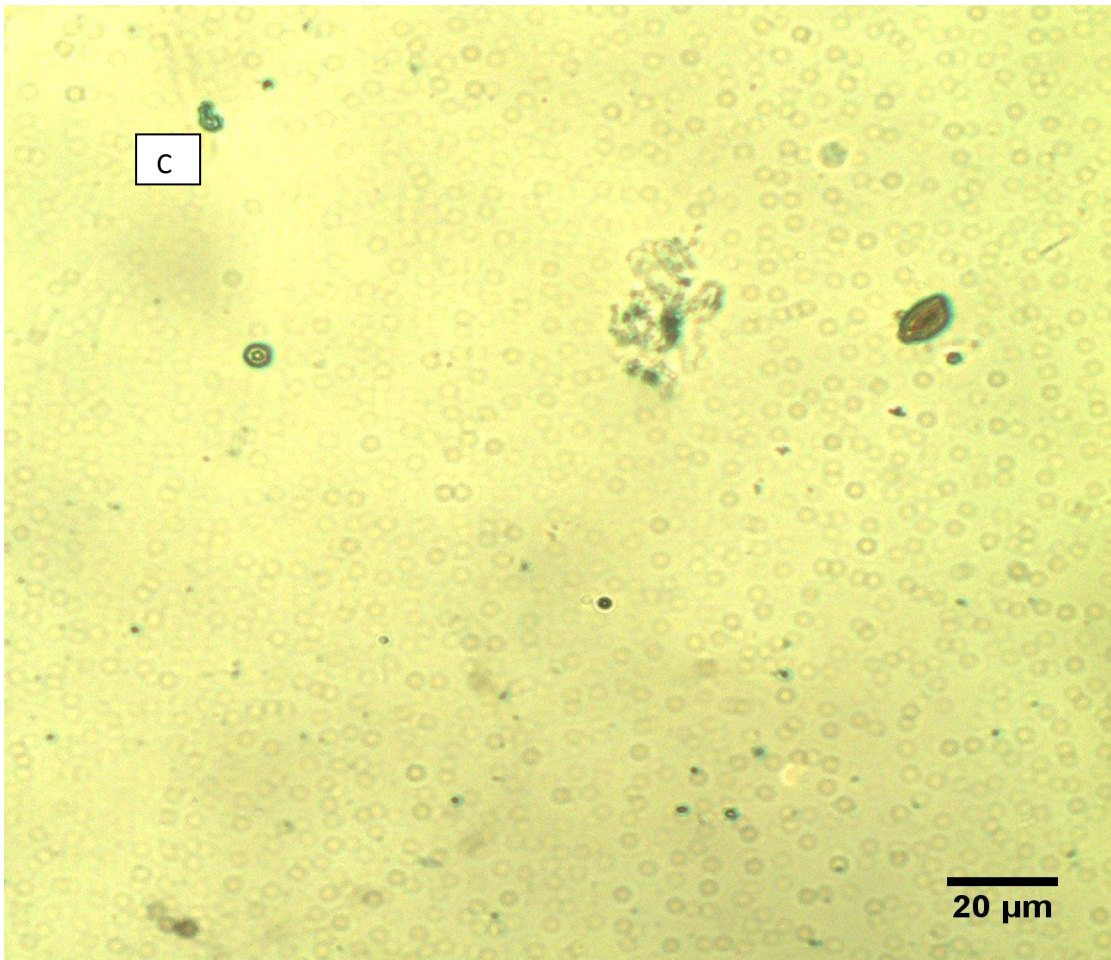
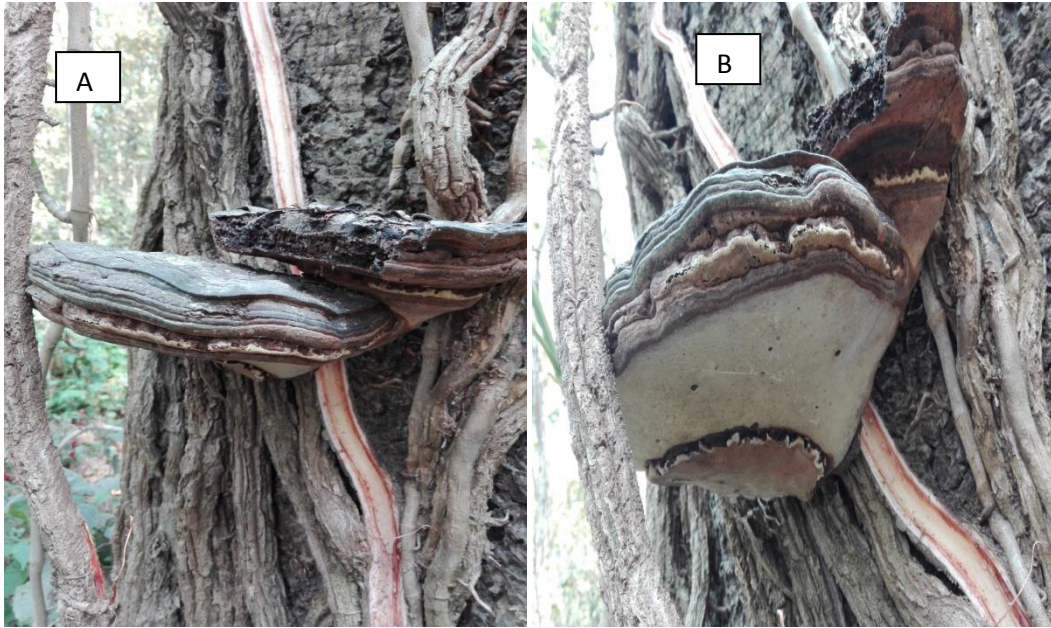


PLATE 5. *Ganoderma applanatum*; Mature fruiting body, Cap (A), Pores (B), Spores (C).

4.3.3 *Ganoderma lucidum*

Common name: Reishi mushroom

Family: Ganodermataceae.

Morphology of *Ganoderma lucidum*

Average size of fructification was 4.2×3.8 cm. The color of pileus (cap) was yellowish white. The shape of cap was bell shaped and flat shaped. The cap edge was round and wavy. Beneath the cap hymenophores were absent. Regular shaped pores were present underside of the cap. The color of pores was white. Ring or anal was absent on the stipe and volva was absent. The texture of the fruiting body was spongy and brittle. Spore color was hyaline, spore shaped were double walled, rough and irregular shaped and spore size was 7.03×4.86 μm (Plate-6).

Habitat of *Ganoderma lucidum*

The mushroom was found on Sal tree. Average Relative Humidity was 82%, soil pH was 7.5 and soil type was mixed with sandy clay. Average recorded temperature was 23⁰C.

Biodiversity of *Ganoderma lucidum*

Ganoderma sp. was found in Madhupur Upazila of Tangail District. A total five number of mushrooms of *Ganoderma* sp. were found during the collection. The frequency of its presence was 33.33% and the density was 16.66%.

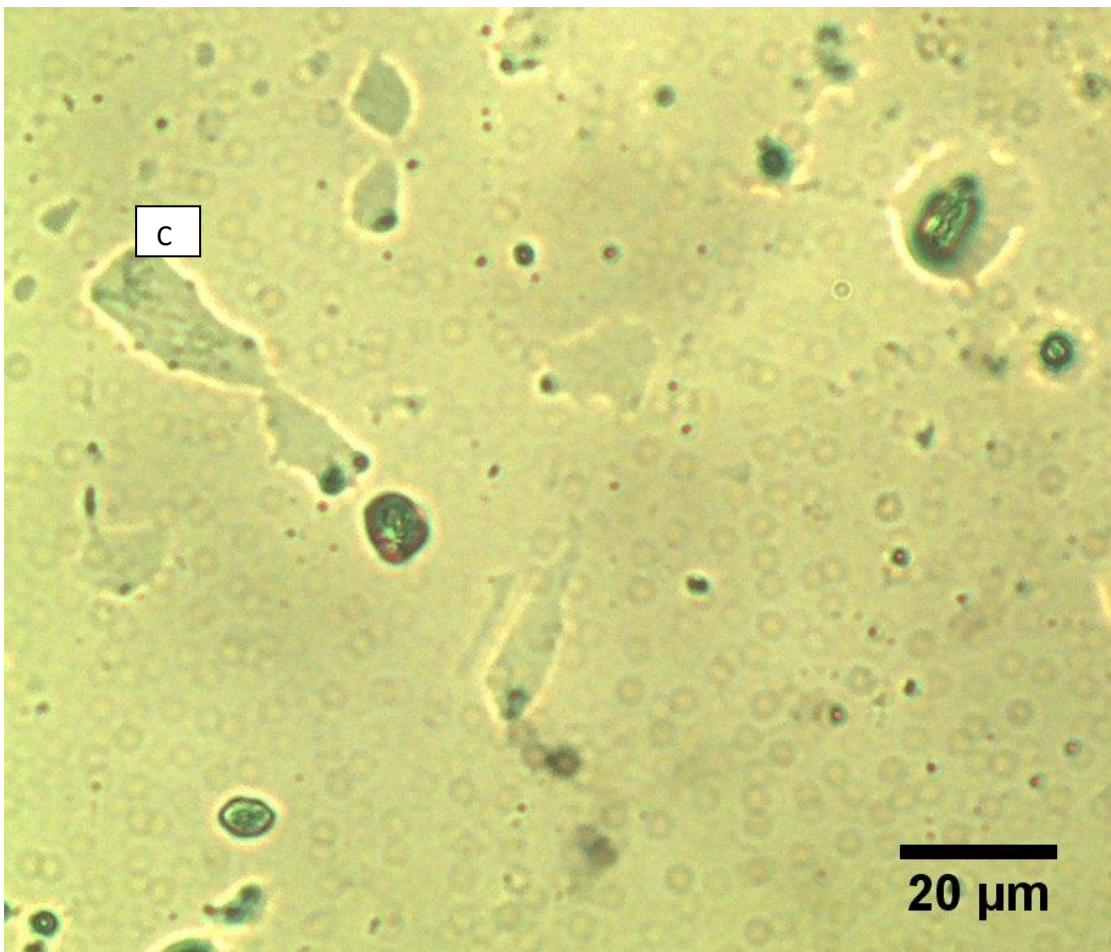


PLATE 6. *Ganoderma lucidum* Mature fruiting body, Cap (A), Pores (B), Spores (C)

4.3.4 *Ganoderma lipsiense*

Common name: Lingzhi and Reishi mushroom.

Family: Ganodermataceae.

Morphology of *Ganoderma lipsiense*

Ganoderma lipsiense fruit bodies was found on the Sal tree of Sal forest, the color of the fruit bodies was dark brown to cocoa coloured. The shape of cap was convex and the cap margin was very much curved but the cap surface was smooth. No scale was found on the cap. Regular shaped pores was present underside of the cap and it was milky coffee color. No Stem was found underside of the cap. Texture of the fruiting body was hard. Ring or anal was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore shape: Triangle, white in color, Single walled, irregular, spore size was 6.4×4.5 μm (Plate 7).

Habitat of *Ganoderma lipsiense*

The mushroom was found on the bark of the Sal (*Shorea robusta*) tree of Sal forest. Average Relative Humidity was 72%, soil pH was 6 and soil type was loamy. Average recorded temperature was 24⁰C.

Biodiversity of *Ganoderma lipsiense*

Ganoderma lipsiense was found in the Sal forest region of Birganj Upazila of Dinajpur District. Total 16 number of mushrooms of *Ganoderma lipsiense* were found during the collection. The frequency of its presence was 33.33% and the density was 53.33%.

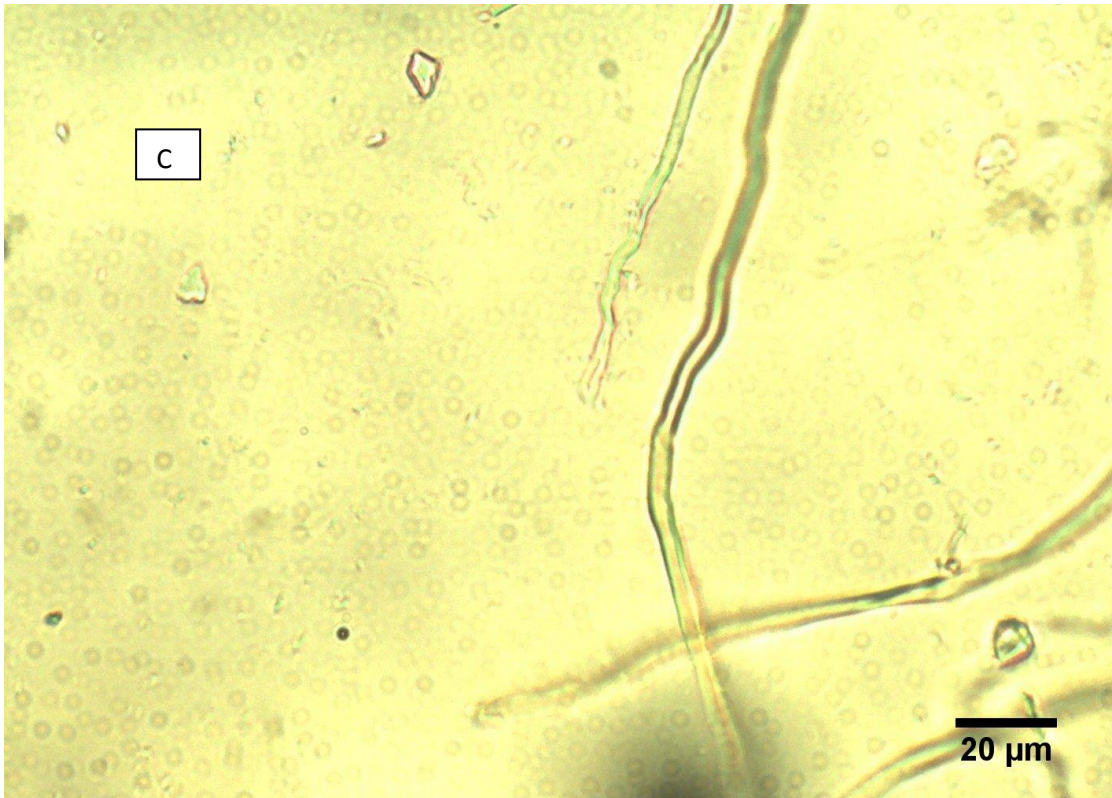
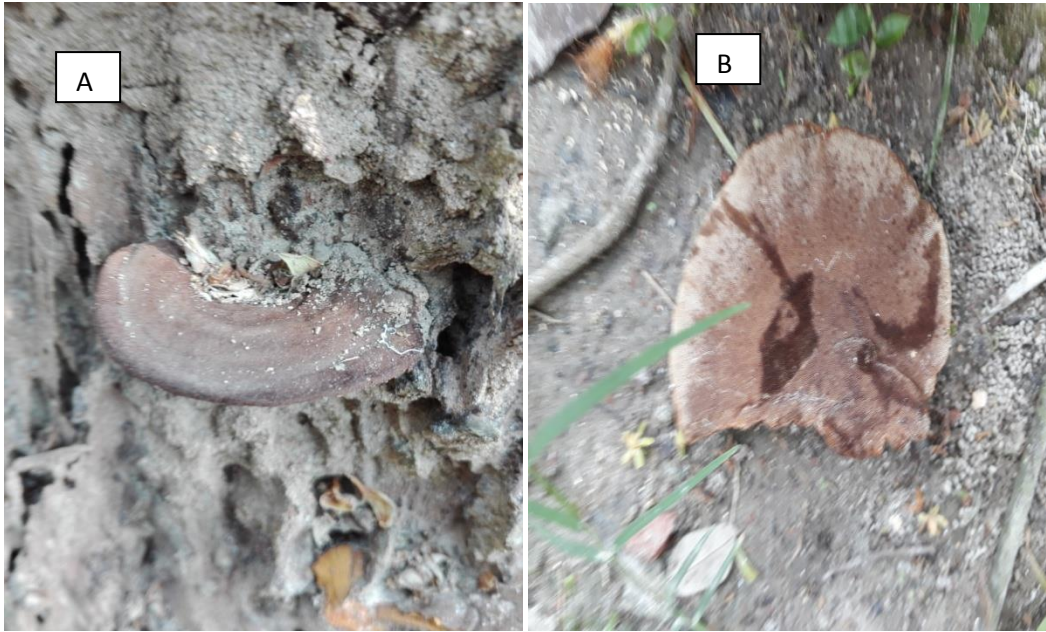


PLATE 7. *Ganoderma lipsiense*; Mature fruiting body, Cap (A), Pores (B), Spores (C).

4.4 Biodiversity, distribution and morphological characterization of *Schizophyllum* sp.

4.4.1 *Schizophyllum commune*

Common name: Split gill.

Family: Schizophyllaceae.

Morphology of *Schizophyllum commune*

Average size of fructification was 2.2×1.3 cm. The color of pileus (cap) was light brown. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was slightly brown. Ring or annulus was absent on the stipe and volva was absent on

the lower part of the stipe. Spore color was brown, spore shaped were double walled, ellipsoidal, rough and average spore size was 7.6×4.99 µm (Plate-8).

Habitat of *Schizophyllum commune*

The mushroom was found on the dead Sal tree (*Shorea robusta*). Average Relative Humidity was 82%, soil type was mixed with red sandy clay. Average recorded temperature was 23°C.

Biodiversity of *Schizophyllum commune*

Schizophyllum commune was found in Madhupur Upazila of Tangail district. A total nine number of mushrooms of *Schizophyllum commune* were found during the collection. The frequency of its presence was 33.33% and the density was 30%.

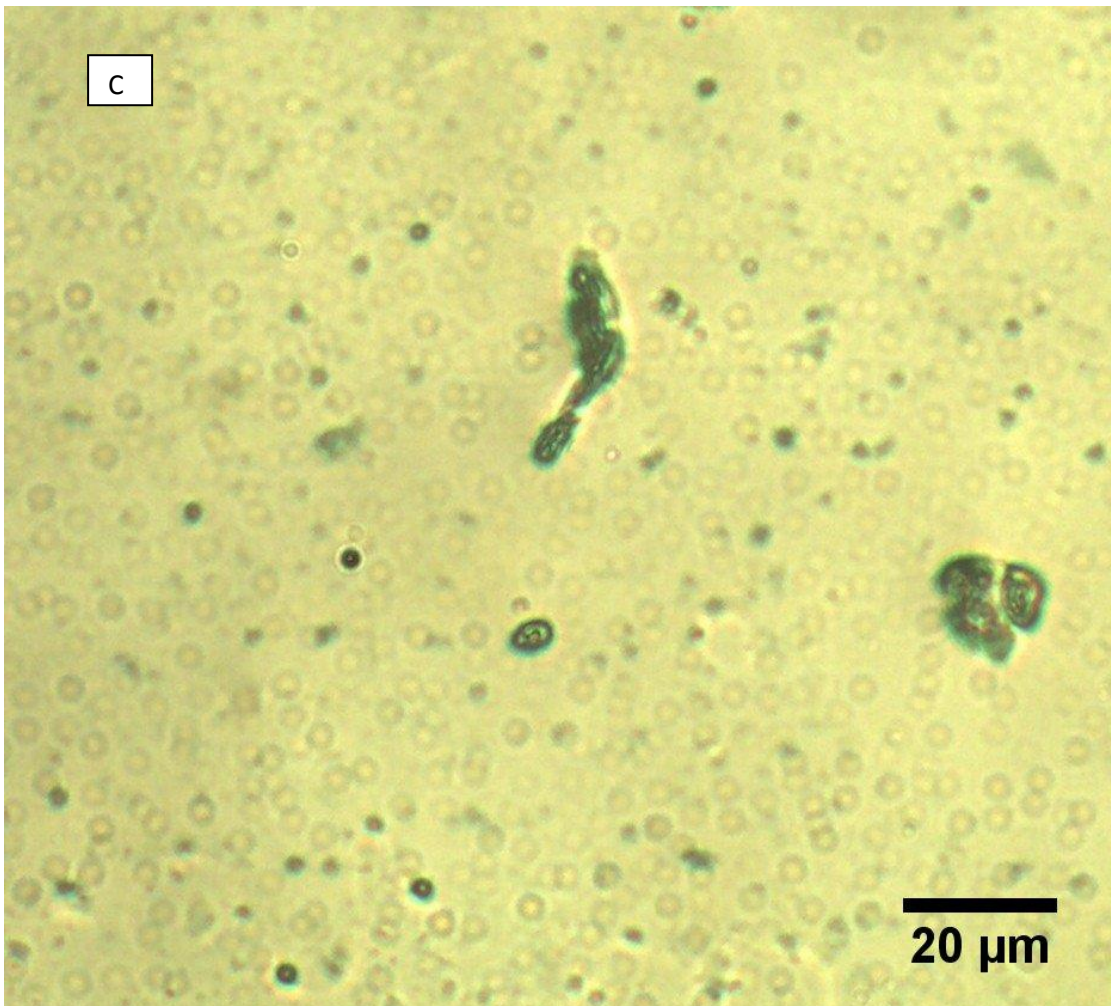
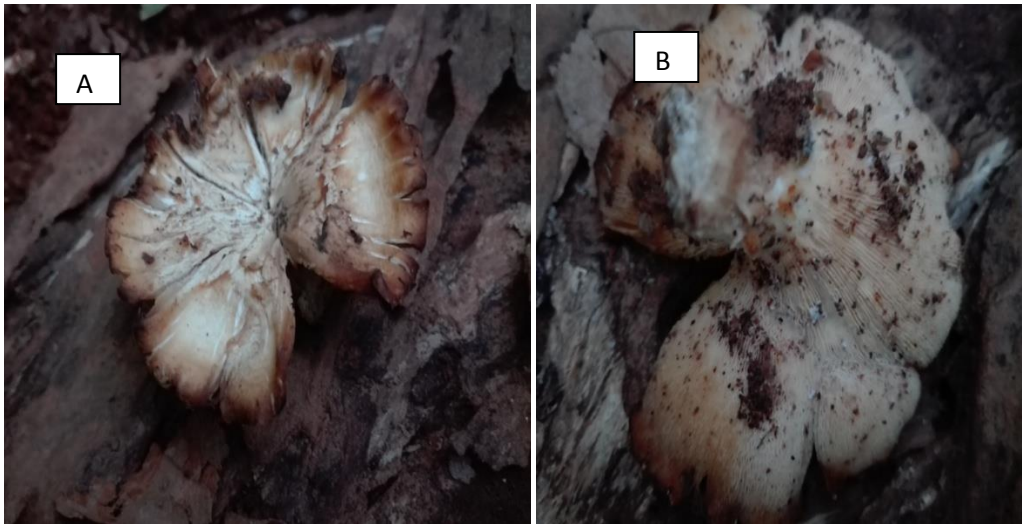


PLATE 8. *Schizophyium commune*; Mature fruiting body, Cap (A), Gill (B), Spores (C).

4.5 Biodiversity, distribution and morphological characterization of *Trametes sp.*

4.5.1 *Trametes versicolor*

Common name: Turkey tail.

Family: Polyporaceae.

Morphology of *Trametes versicolor*

The size of fructification was 5.8×6.1 cm. The color of pileus (cap) was brick red. The shape of cap was convex shaped. The cap edge was triangular or round. Beneath the cap hymenophores were absent. Regular shaped pores were present underside of the cap. The color of pore was brownish. Spore color was brown, spore shaped were single walled, rough, irregular and oval shaped. The average spore size was 6.1×4.38 μm (Plate-9).

Habitat of *Trametes versicolor*

The mushroom was found on the dead bark of Sal (*Shorea robusta*) tree. Average Relative Humidity was 82%, soil pH was 7.5 and soil type was mixed with sandy clay. Average recorded temperature was 23⁰C.

Biodiversity of *Trametes versicolor*

Trametes versicolor was found in Madhupur Upazila of Tangail district. Four number of mushroom of *Trametes versicolor* were found during the collection. The frequency of its presence was 33.33% and the density was 13.33%.

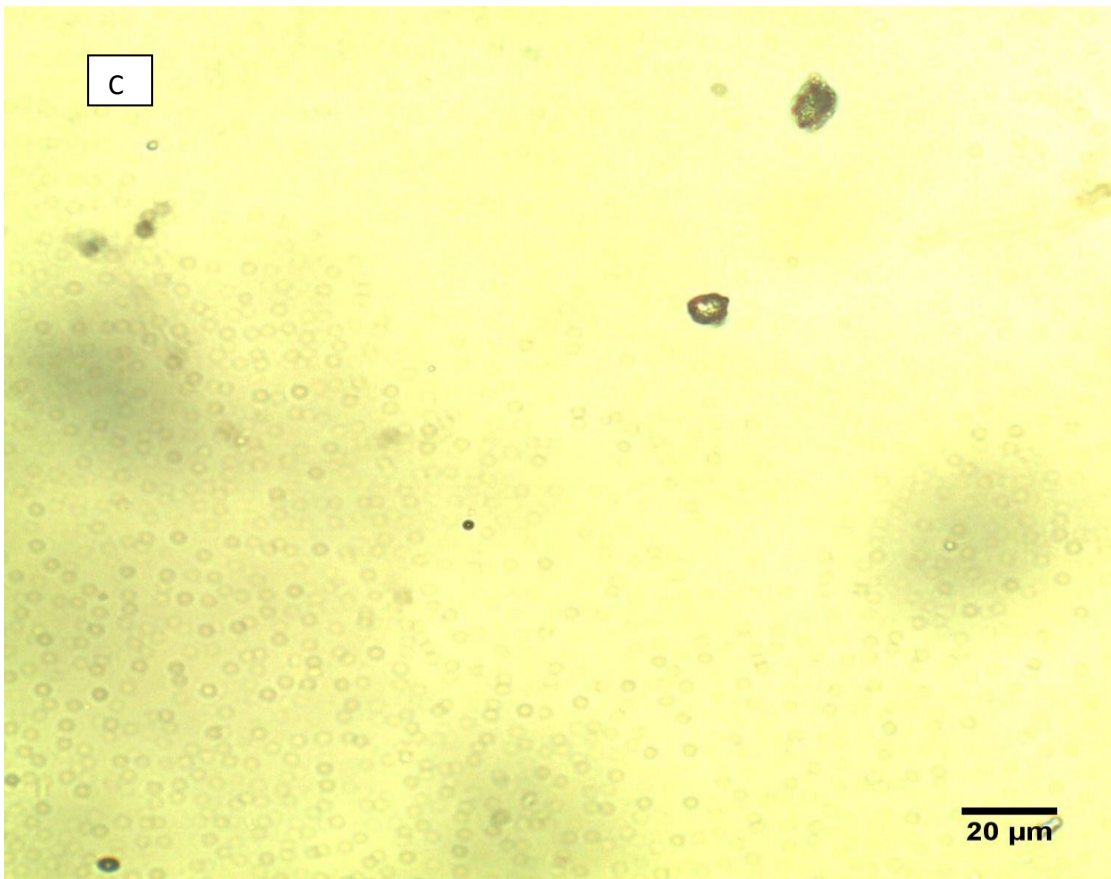
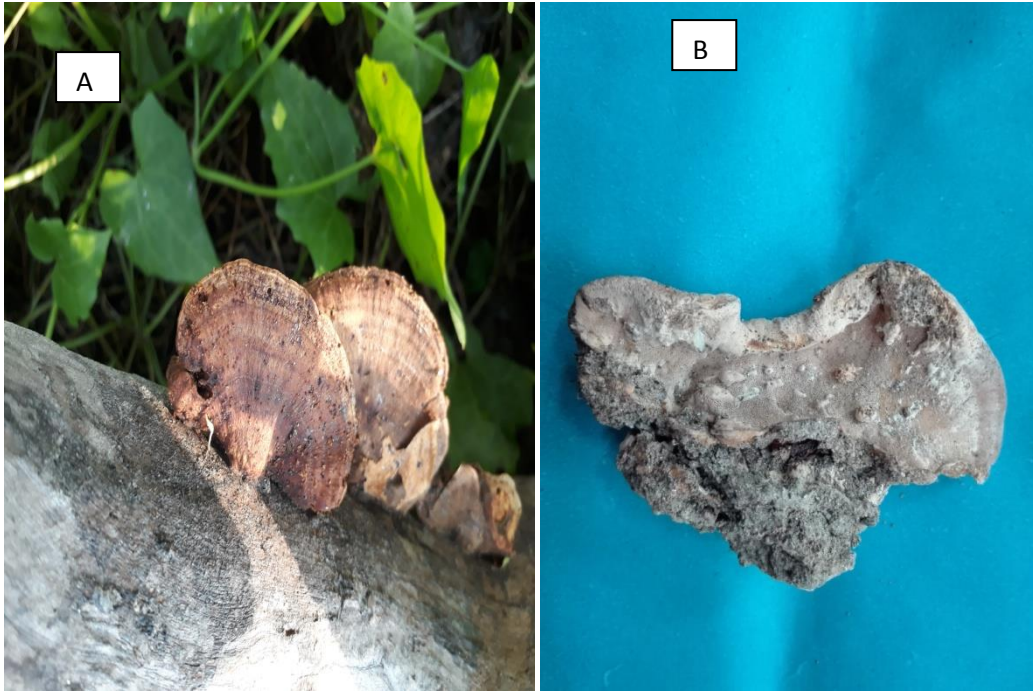


PLATE 9. *Trametes versicolor*; Mature fruiting body, Cap (A), Pore (B), Spores (C).

4.6 Biodiversity, distribution and morphological charecterization of *Macrolepiotia sp.*

4.6.1 *Macrolepiotia procera*

Common name: Parasol mushroom.

Family: Lepiotaceae.

Morphology of *Macrolepiotia procera*

Size of fructification was 15-17×8-9 cm. The color of pileus (cap) was white and tip portion is pink. The shape of cap was convex and umbonate shaped. The cap edge was round smooth. Fleshy brown color scale was found on the cap. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was white. Color of stipe was whitish. The length and width of stipe was 7-8 cm and 2-3 cm, respectively. Ring or anal was present on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, structure was single walled, smooth, oval shaped and size of spore was 7.9-8.1×5-6 μm (Plate 10).

Habitat of *Macrolepiotia procera*

The mushroom was found on the soil. Average Relative Humidity was 82%, soil pH was 6 and soil type was loamy. Average recorded temperature was 26°C.

Biodiversity of *Macrolepiotia procera*

Macrolepiotia procera was found in Madhupur and Mithapukur upazila of Tangail and Rangpur District. A total fourteen number of mushrooms of *Macrolepiotia procera* were found during the collection. The frequency of its presence was 66.66% and the density was 46.66%.

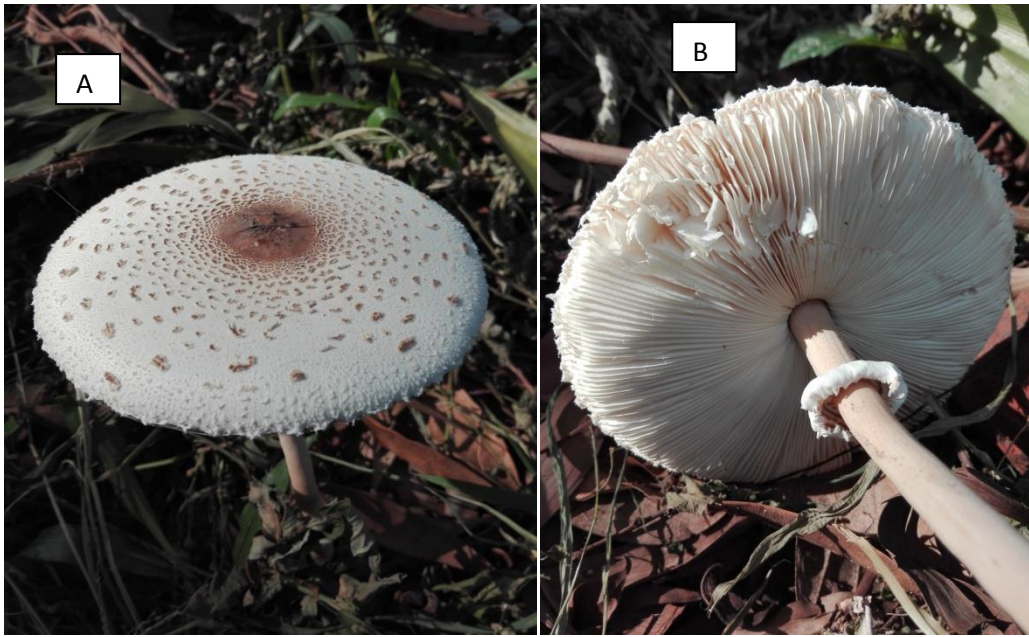


PLATE 10. *Macrolepiota procera*; Mature fruiting body, Cap (A), Gill (B), Spores (C).

4.7 Biodiversity, distribution and morphological characterization of *Volvariella sp.*

4.7.1 *Volvariella gloiocephala*

Common name: Big sheath mushroom.

Family: Pluteaceae.

Morphology of *Volvariella gloiocephala*

Size of fructification was 6-7×4-5 cm. The color of pileus (cap) was yellowish white color. The shape of cap was convex and flat. The cap edge was grooved. Yellow color scale was found on the cap. Beneath the cap hymenophores were present. Regular shaped gills (lamellae) were present underside of the cap. The color of stipe was yellow color. The length and width of stipe was 4-5 cm and 1.5-3 cm, respectively. Gills were present and color of gills is creamy brown. Ring or anal was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore color was brown, spore shaped were double walled, smooth and ellipsoidal and spore size was 6-8×3-4 μm (Plate 11).

Habitat of *Volvariella gloiocephala*

The mushroom was found on the soil. Average Relative Humidity was 80%, soil pH was 6 and soil type was loamy. Average recorded temperature was 28°C.

Biodiversity of *Volvariella gloiocephala*

Volvariella gloiocephala was found in Mithapukur Upazila of Rangpur District. A total seven number of mushrooms of *Volvariella gloiocephala* were found during the collection. The frequency of its presence was 33.33% and the density was 23.33%.

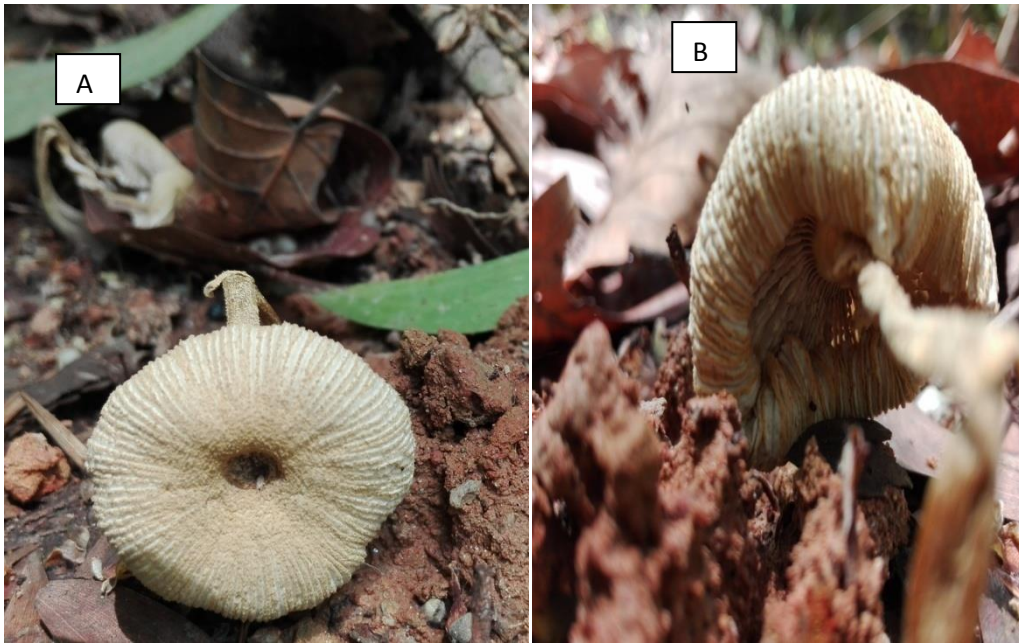


PLATE 11. *Volvariella gloiocephala*; Mature fruiting body, Cap (A), Gill (B), Spores (C).

4.8 Biodiversity, distribution and morphological characterization of *Craterellus sp.*

4.8.1 *Craterellus cornucopioides*

Common name: Horn of Plenty.

Family: Cantharellaceae.

Morphology of *Craterellus cornucopioides*

Color (young) was yellowish white, length 6 cm and width 5 cm, spore bearing surface under cap was gills. Cap of the carpophore size was infundibuliform, pileus color was yellow, surface characters and zonation was moist. Pileus margin was incurved, pileus cuticle was not peeling, texture of the fruiting body was brittle. Lamellae absent, gill spacing was close, lamellulae was present, forking pattern was unbranched. Stipe was present, shape was equal, veil absent. Annulus (position) absent, volva absent, scale absent. Spore was hyaline, single walled, round shaped, size of spore was 2.6-3.4 μm (Plate 12).

Habitat of *Craterellus cornucopioides*

The mushroom was found on the Sal tree (*Shorea robusta*). Average Relative Humidity was 82%, soil pH was 6 and soil type was sandy clay. Average recorded temperature was 23°C.

Biodiversity of *Craterellus cornucopioides*

Craterellus cornucopioides was found in Madhupur Upazila of Tangail District. A total 15 number of mushrooms of *Craterellus cornucopioides* were found during the collection. The frequency of its presence was 33.33% and the density was 50%.

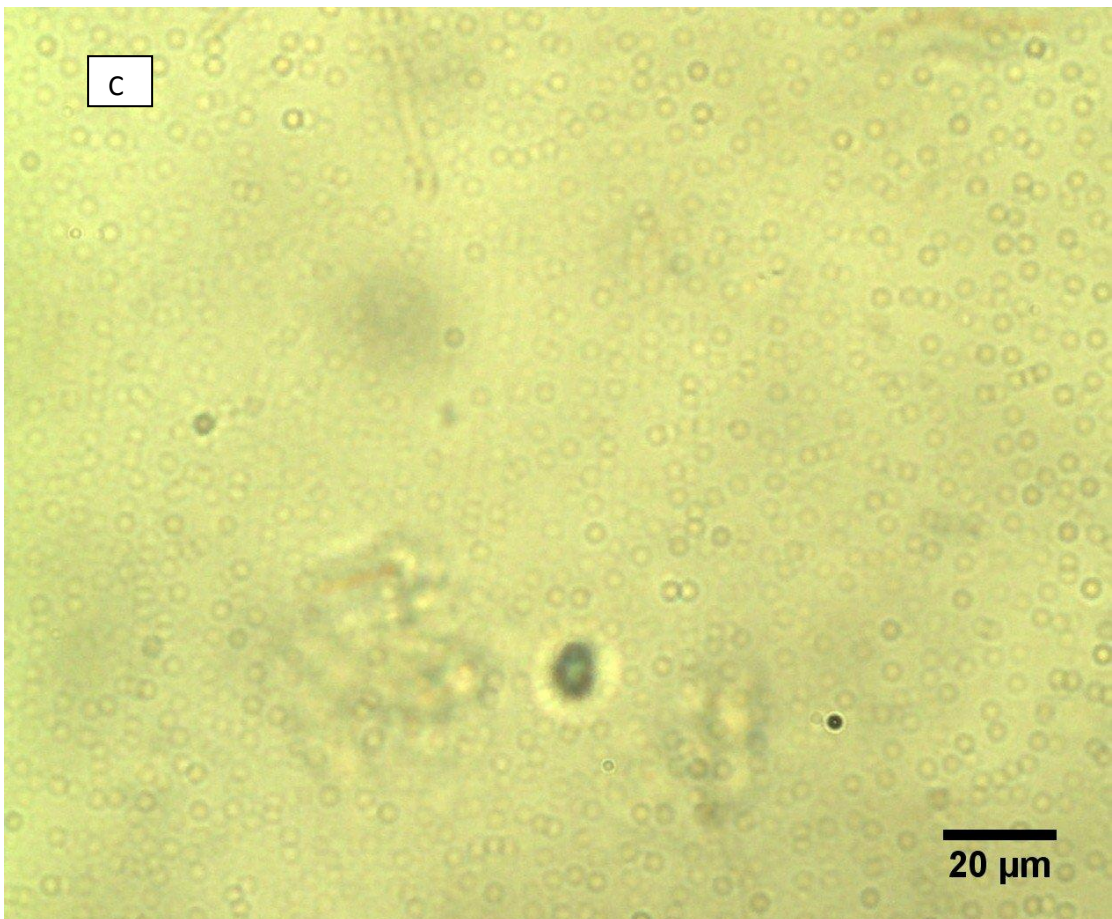
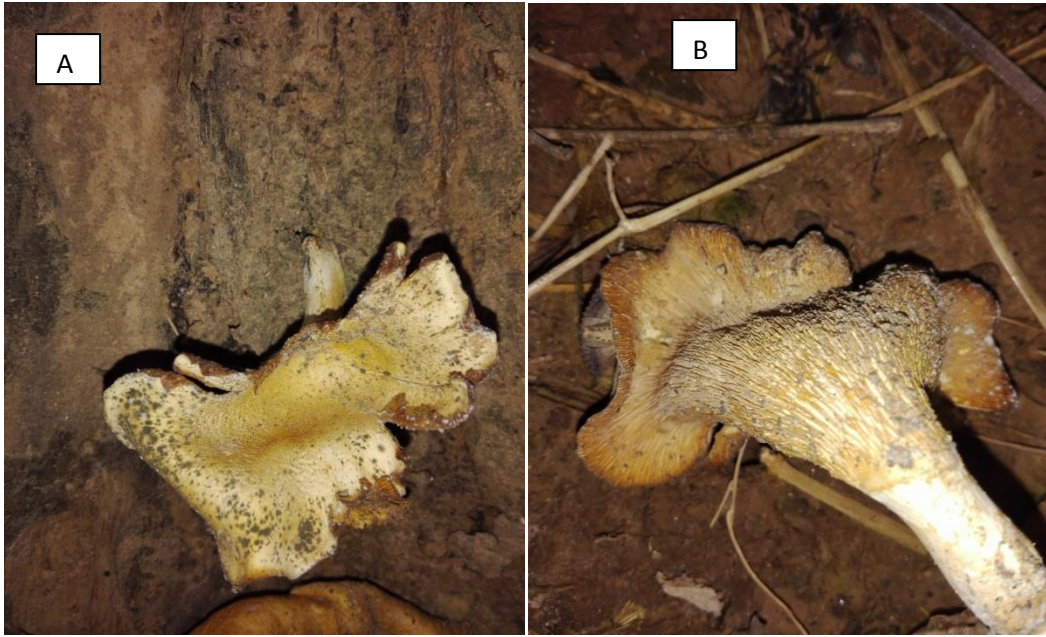


PLATE 12. *Craterellus cornucopioides*; Mature fruiting body, Cap (A), Gill (B), Spores (C).

4.9 Biodiversity, distribution and morphological characterization of *Termitomyces sp.*

4.9.1 *Termitomyces heimii*

Family: Lyophyllaceae.

Morphology of *Termitomyces heimii*

Size of fructification was 3-4×2-3 cm. The color of pileus (cap) was white color. The shape of cap was flat. Yellow color scale was found on the cap. Beneath the cap hymenophores were present. Regular shaped gills (lamellae) were present underside of the cap. Texture of the fruiting body was Soft and spongy. The color of stipe was white color. The length and width of stipe was 3-5 cm and 1.5-3 cm, respectively. Gills were present and color of gills is white. Ring or anal was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore shape: Single walled, smooth and cylindrical as well as ellipsoid and spore size was 6-7×3.1-4 µm (Plate 13).

Habitat of *Termitomyces heimii*

The macrofungi was found on the soil of the forest. Average Relative Humidity was 82%, soil pH was 6 and soil type was loamy. Average recorded temperature was 26°C.

Biodiversity of *Termitomyces heimii*

Termitomyces heimii was found in Madhupur and Mithapukur Upazila of Tangail and Rangpur District. A total 7 number of mushrooms of *Termitomyces heimii* were found during the collection. The frequency of its presence was 66.66% and the density was 23.33%.

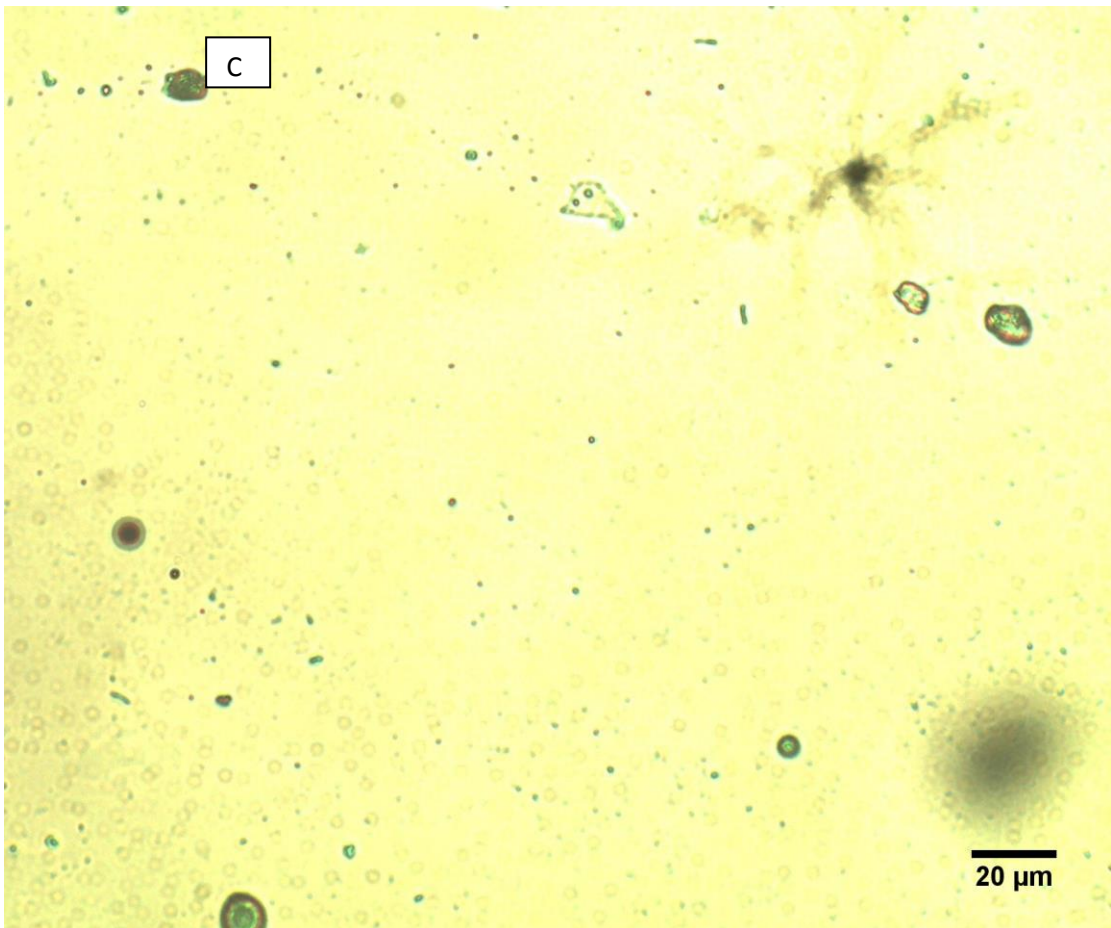
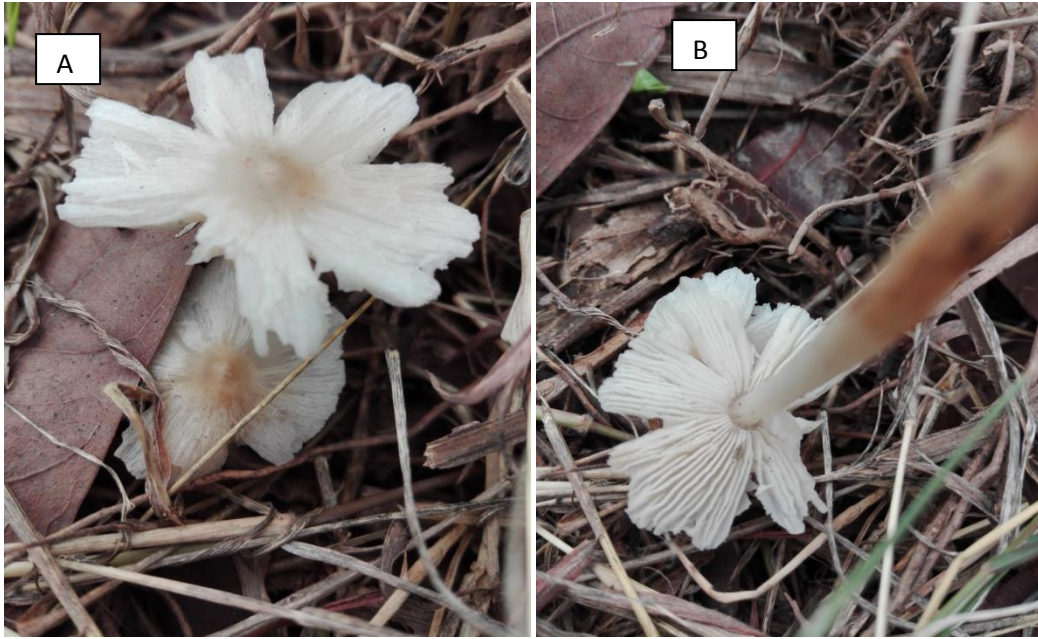


PLATE 13. *Termitomyces heimii*; Mature fruiting body, Cap (A), Gill (B), Spores (C)

4.10 Biodiversity, distribution and morphological characterization of *Borofutus* sp.

4.10.1 *Borofutus dhakanus*

Family:Boletaceae.

Morphology of *Borofutus dhakanus*

Size of fructification was 5-7×4-5 cm. The color of pileus (cap) was deep brown color. The shape of cap was convex. No scale was found on the cap. Regular shaped pores were present underside of the cap. Texture of the fruiting body was brittle. The color of stipe was reddish color. The length and width of stipe was 4.5-5.5 cm and 1.5-3 cm, respectively. Pore color was light brown. Ring or anal was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore shape:double walled, smooth and cylindrical and spore size was 7.7-8 × 3.6-4 μm (Plate 14).

Habitat of *Borofutus dhakanus*

The mushroom was found on the soil near the sal tree. Average Relative Humidity was 72%, soil pH was 6 and soil type was loamy. Average recorded temperature was 24°C.

Biodiversity of *Borofutus dhakanus*

Borofutus dhakanus was found in the Singra forest region soil of Birganj Upazila of Dinajpur District. Only one number of mushrooms of *Borofutus dhakanus* were found during the collection. The frequency of its presence was 33.33% and the density was 3.33%.

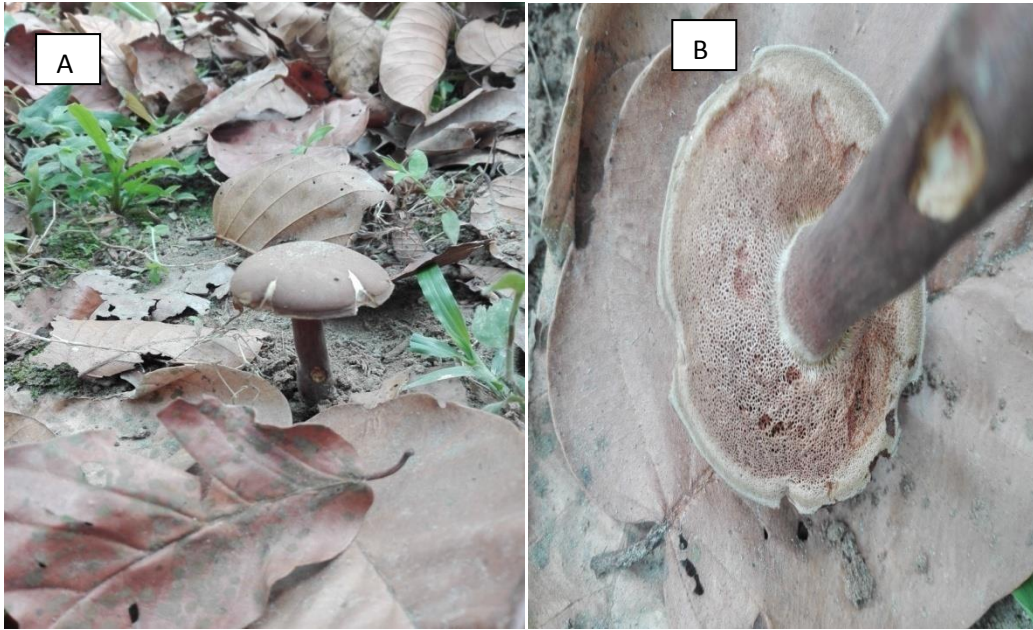


PLATE 14. *Borofutus dhakanus*; Mature fruiting body, Cap (A), Pores (B), Spores (C).

4.11 Biodiversity, distribution and morphological characterization of *Laetiporus sp.*

4.11.1 *Laetiporus sulphurus*

Family: Polyporaceae.

Common names: Crab of the woods, Sulphur polypore, Sulphur shelf, and Chicken of the woods.

Morphology of *Laetiporus sulphurus*

Laetiporus sulphurus fruit bodies was found on Sal tree, the color of the fruit bodies was pale yellow in color. The shape of cap was bracket shaped and the cap margin was wavy but the cap surface was smooth. No scale was found on the cap. Regular shaped pores rather than gills were present underside of the cap. Texture of the fruiting body was dry and brittle and it has a strong fungusy smell. Stipe was absent in this mushroom. Pore color was light brown. Ring or anal was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore shape: Rounded, white in color, Single walled, smooth, spore size was 4.5-4.9×3.5 µm (Plate 15).

Habitat of *Laetiporus sulphurus*

The macrofungi was found on the bark of Sal (*Shorea robusta*) tree of the forest. Average Relative Humidity was 82%, soil pH was 7.5 and soil type was mixed with red sandy clay. Average recorded temperature was 23°C.

Biodiversity of *Laetiporus sulphurus*

Laetiporus sulphurus was found in the Sal forest region of Madhupur Upazila of Tangail District. Total four number of mushrooms of *Laetiporus sulphurus* were found during the collection. The frequency of its presence was 33.33% and the density was 13.33%.

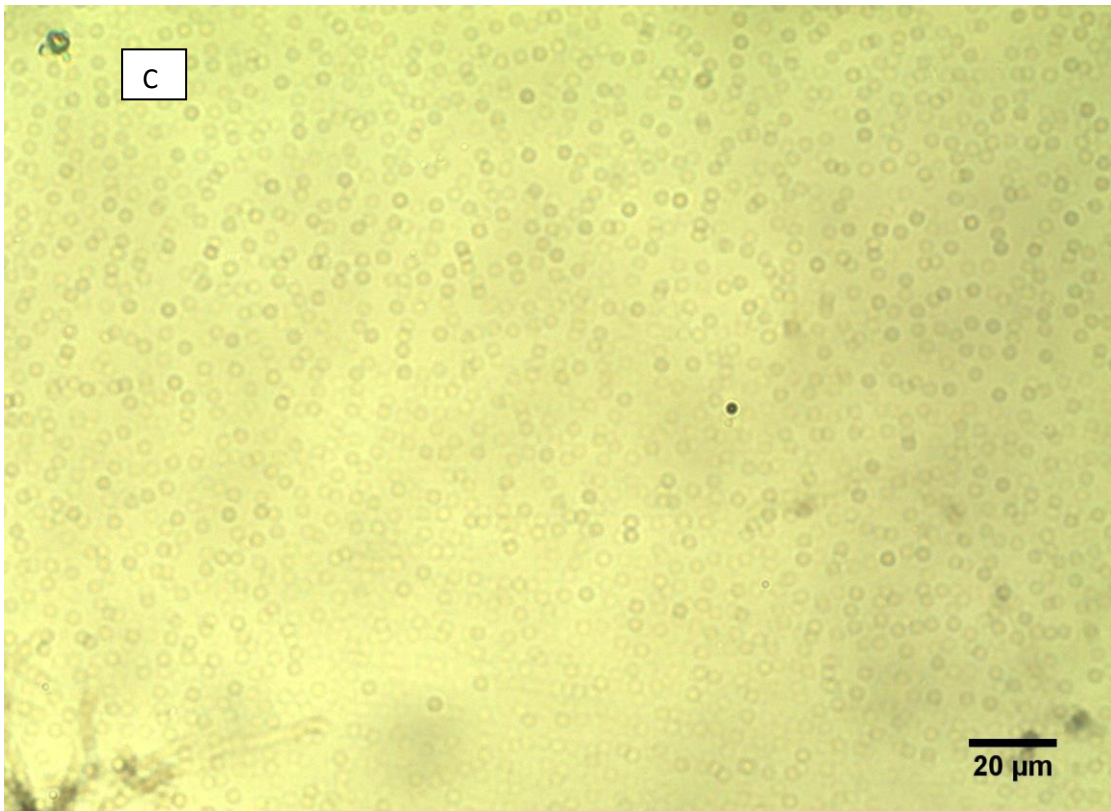
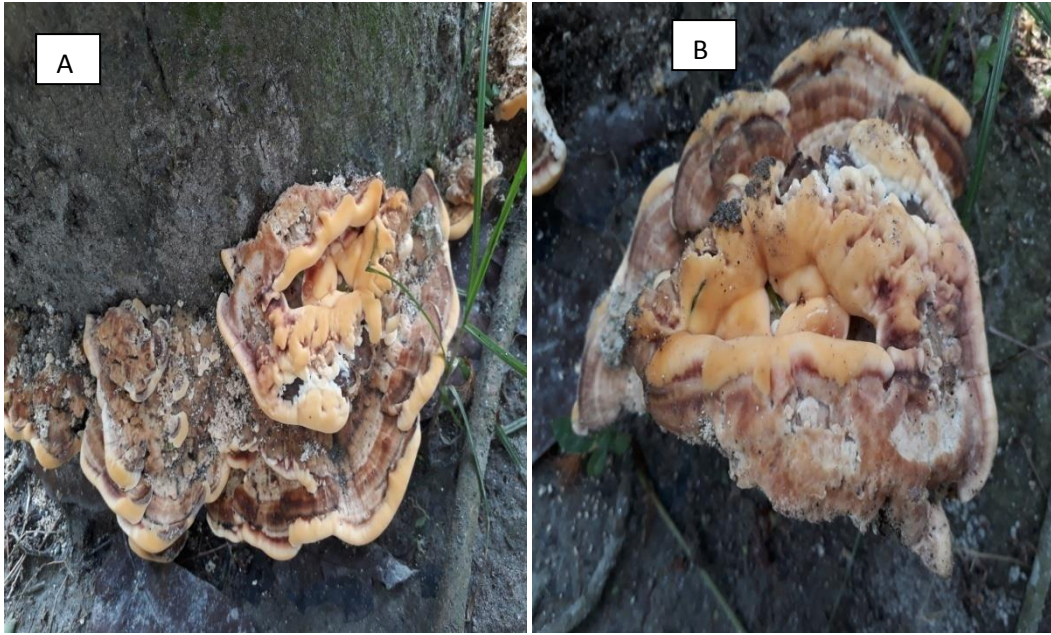


PLATE 15. *Laetiporus sulphureus*; Mature fruiting body, Cap (A), Pores (B), Spores (C).

4.12 Biodiversity, distribution and morphological characterization of *Coprinus sp.*

4.12.1 *Coprinus disseminates*

Family: Psathyrellaceae.

Common names: Fairy inkcap, trooping crumble.

Morphology of *Coprinus disseminates*

Coprinus disseminates is saprobic and occurs mainly in the rotting wood. The color of the fruit bodies was pale yellow in color. White scale was found on the cap. The shape of cap was ovate, egg shaped or bell shaped and the cap margin was wavy. It has adnate gills which is grey in color. Regular shaped gills were present underside of the cap. Texture of the fruiting body was soft and spongy. Stipe was thin and very fragil nearly 2-3 cm tall and 1-2 mm thick. Ring or anal was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore shape: Round, smooth, white in color, Single walled, spore size was 3.4-5.5×2-3.5 µm (Plate 16).

Habitat of *Coprinus disseminates*

The macrofungi was found on the rotting Sal (*Shorea robusta*) tree of the forest. Average Relative Humidity was 82%, soil pH was 6 and soil type was loamy. Average recorded temperature was 26⁰C.

Biodiversity of *Coprinus disseminates*

Coprinus disseminates was found in the Sal forest region of Madhupur and Mithapukur Upazila of Tangail and Rangpur District. Total 17 number of mushrooms of *Coprinus disseminates* were found during the collection. The frequency of its presence was 66.66% and the density was 56.66%.

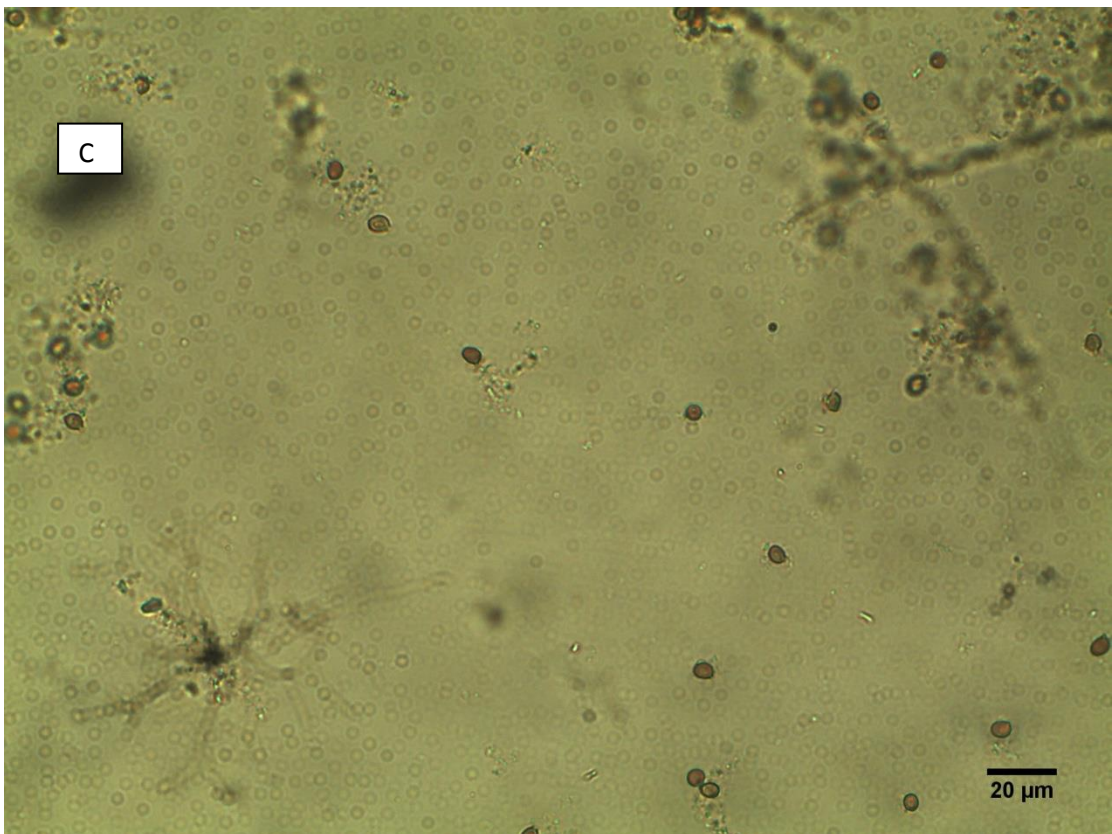


PLATE 16. *Coprinus disseminatus*; Mature fruiting body, Cap (A), Gills (B), Spores (C).

4.13 Biodiversity, distribution and morphological characterization of *Leucocoprinus* sp.

4.13.1 *Leucocoprinus brinbaumii*

Common names: Plantpot dapperling, yellow parasol, flowerpot parasol, yellow houseplant mushroom, lemon yellow lepiota, yellow pleated parasol.

Family: Agaricaceae.

Morphology of *Leucocoprinus brinbaumii*

Leucocoprinus brinbaumii fruit bodies were saprobic, it was found on clustered on soil of Sal forest. The color of the fruit bodies was yellow in color. The shape of cap was Ovate or campanulate and the cap surface was smooth. No scale was found on the cap. Regular shaped pores were present underside of the cap, pores were free from the stem. Texture of the fruiting body was very soft. Stipe sometimes bear ring which is yellow in color. Volva was absent on the lower part of stipe. Spore shape: Ellipsoid, smooth, thick walled, spore size was 6-8 × 4.9-5.9 μm (Plate 17).

Habitat of *Leucocoprinus brinbaumii*

The mushroom was found on the soil of the Sal forest. Average Relative Humidity was 80%, soil pH was 6 and soil type was loamy. Average recorded temperature was 28°C.

Biodiversity of *Leucocoprinus brinbaumii*

Leucocoprinus brinbaumii was found in the Sal forest region of Mithapukur Upazila of Rangpur District. Total 11 number of mushrooms of *Leucocoprinus brinbaumii* were found during the collection. The frequency of its presence was 33.33% and the density was 36.66%.

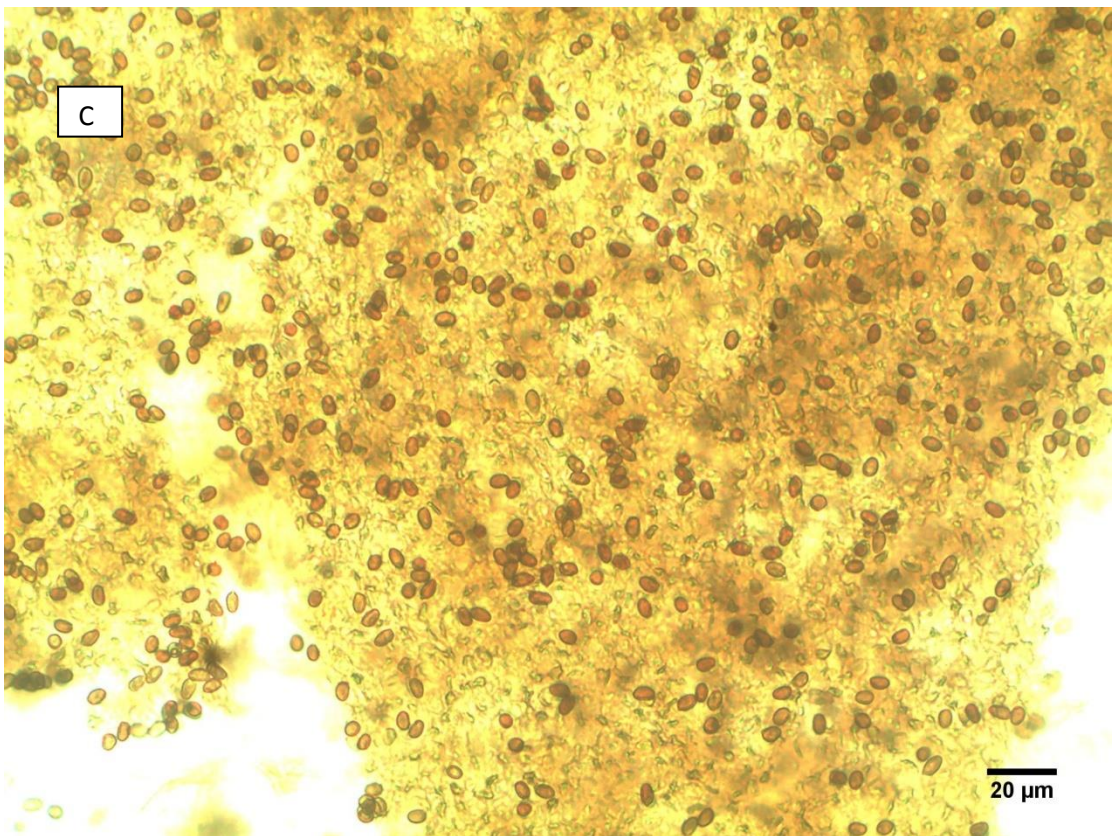


PLATE 17. *Leucocoprinus birnbaumii*; Mature fruiting body, Cap (A), Pore (B), Spores (C)

4.14 Biodiversity, distribution and morphological characterization of *Lepista sp.*

4.14.1 *Lepista sordida*

Common name: Fairy ring.

Family:Tricholomataceae.

Morphology of *Lepista sordida*

Lepista sordida fruit bodies was deep violet/brown color. The shape of cap was infundibuliform or depressed and the cap surface was not smooth. No scale was found on the cap. Regular shaped gills were present underside of the cap, gills were greyish in color. Texture of the fruiting body was very brittle. Stipe has no ring. Volva was absent on the lower part of stipe. Spore shape: Ellipsoid, smooth, brown color, spore size was 7.3-8.8×5-7.5 μm (Plate 18).

Habitat of *Lepista sordida*

The macrofungi was found on the bark of the Sal (*Shorea robusta*) tree of Sal forest. Average Relative Humidity was 82%, soil pH was 7.5 and soil type was mixed with red sandy clay. Average recorded temperature was 23°C.

Biodiversity of *Lepista sordida*

Lepista sordida was found in the Sal forest region of Madhupur Upazila of Tangail District. Total two number of mushrooms of *Lepista sordida* were found during the collection. The frequency of its presence was 33.33% and the density was 6.66%.

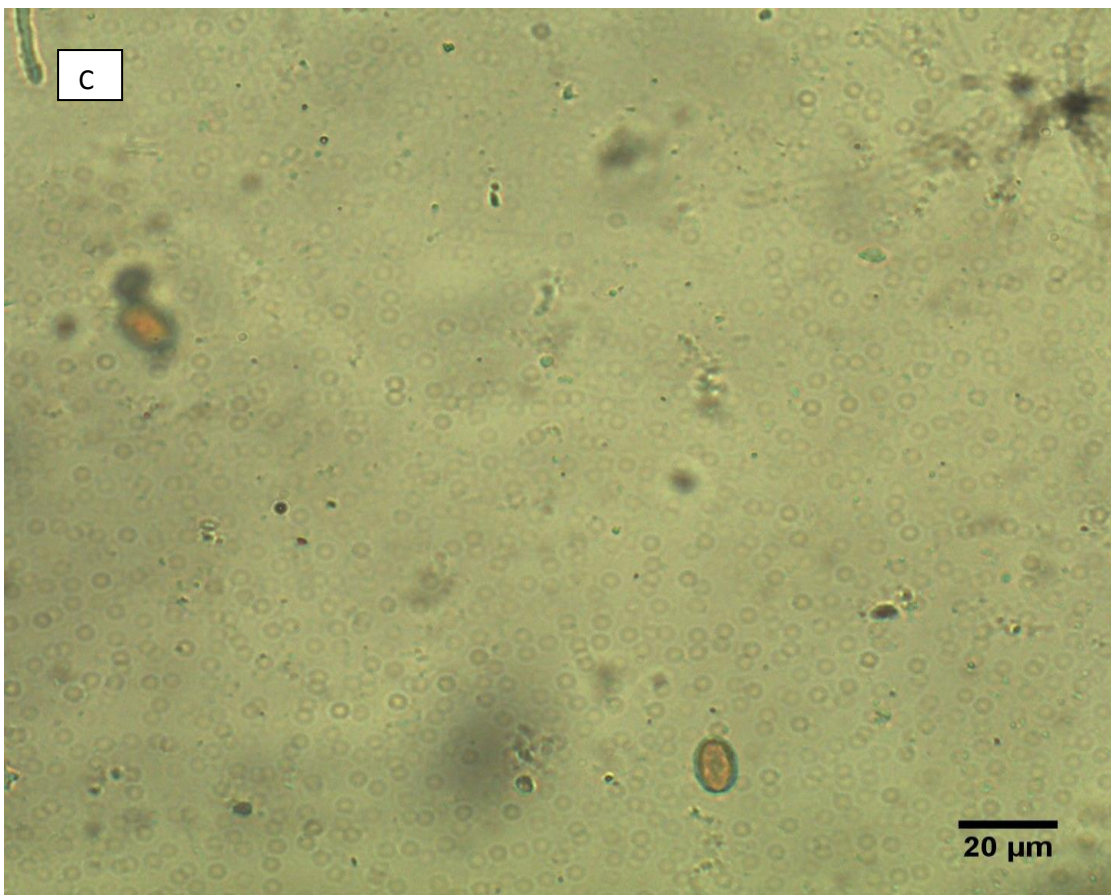


PLATE 18. *Lepista sordida*; Mature fruiting body, Cap (A), Gills (B), Spores (C).

4.15 Biodiversity, distribution and morphological characterization of *Polyporus* sp.

4.15.1 *Polyporus* sp.

Family:Polyporaceae

Morphology of *Polyporus* sp.

Polyporus sp. fruit bodies was found on Sal tree, the color of the fruit bodies was dark yellow in color. The shape of cap was round shaped and the cap margin was wavy but the cap surface was smooth. No scale was found on the cap. Regular shaped pores rather than gills were present underside of the cap. Texture of the fruiting body was dry and soft. Stipe was absent in this mushroom. Pore color was light brown. Ring or annulus was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore shape: Rounded, brown in color, double walled, smooth, spore size was 8.4×6.5 μm (Plate 19).

Habitat of *Polyporus* sp.

The mushroom was found on the bark of the Sal (*Shorea robusta*) tree of Sal forest. Average Relative Humidity was 72%, soil pH was 6 and soil type was loamy. Average recorded temperature was 24°C.

Biodiversity of *Polyporus* sp.

Polyporus sp. was found in the Sal forest region of Birganj Upazila of Dinajpur District. Total five numbers of mushrooms of *Polyporus sp.* were found during the collection. The frequency of its presence was 33.33% and the density was 16.66%.

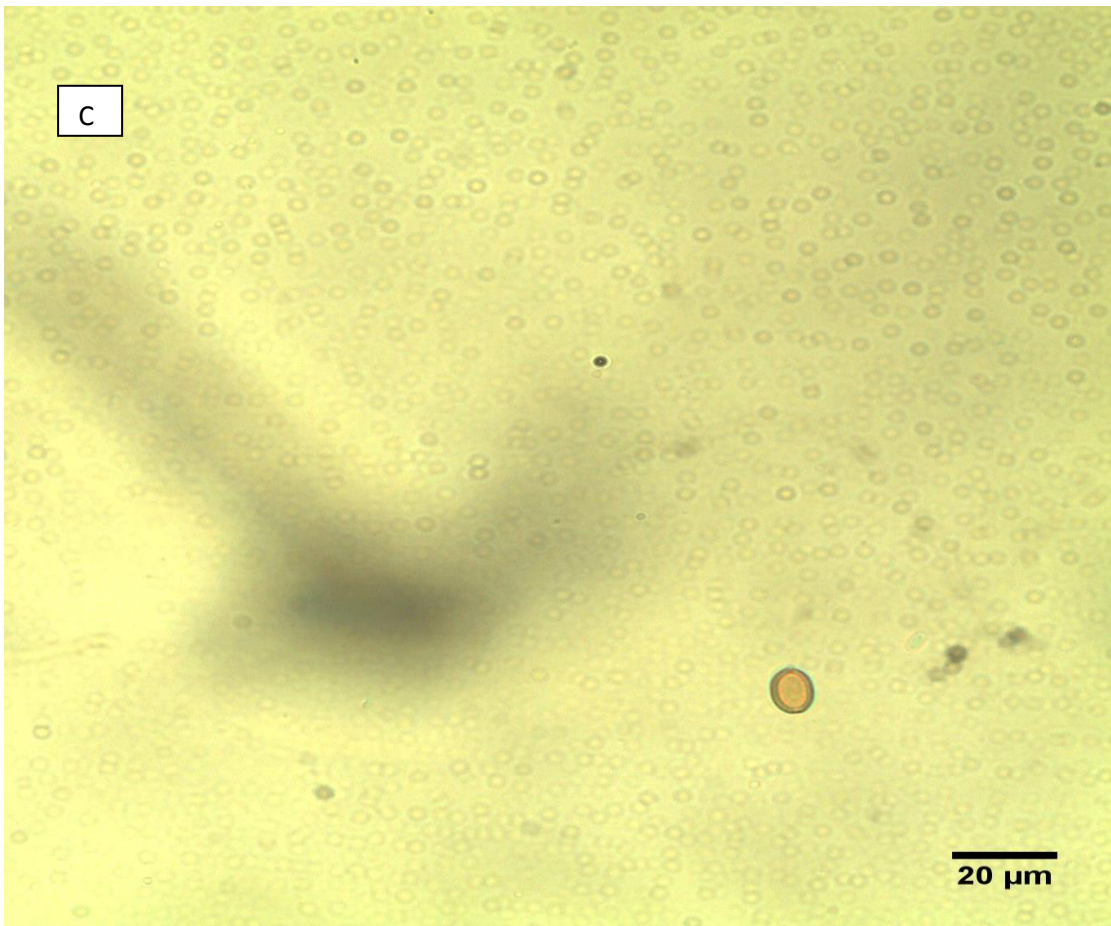
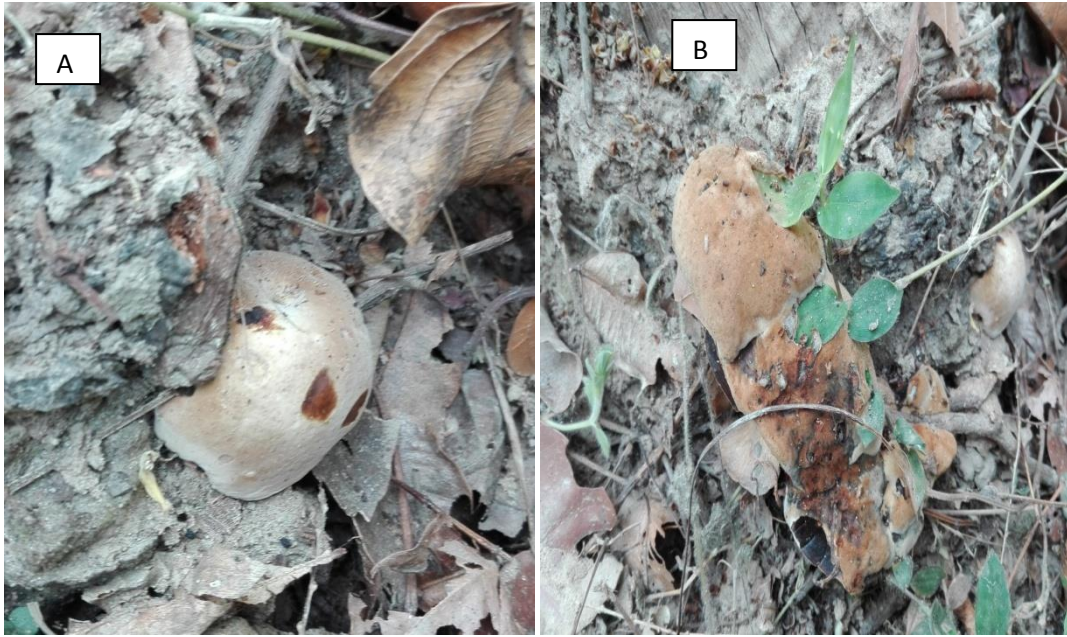


PLATE 19. *Polyporus* sp; Mature fruiting body, Cap (A), Pore (B), Spores (C).

4.16 Biodiversity, distribution and morphological characterization of *Lepiota* sp.

4.16.1 *Lepiota humei*

Family: Agaricaceae

Morphology of *Lepiota humei*

Lepiota humei fruit bodies were found on the soil, the color of the fruit bodies was white. The shape of cap was convex shaped, the cap margin and the cap surface was smooth. The gills beneath the cap are white to creamy color and are free (not joined to the stem). No scale was found on the cap. Texture of the fruiting body was very soft and spongy. It has a very slender white color stipe. Ring or annulus was present on the upper part of stipe and volva was present on the lower part of stipe. Spore shape: Ellipsoid, brown in color, single-walled, smooth, spore size was 7.4×5.5 μm (Plate 20).

Habitat of *Lepiota humei*

The macrofungi was found on the soil of the Sal (*Shorea robusta*) tree of Sal forest. Average Relative Humidity was 80%, soil pH was 6 and soil type was loamy. Average recorded temperature was 28°C.

Biodiversity of *Lepiota humei*

Lepiota humei was found in the Sal forest region of Mithapukur Upazila of Rangpur District. Total 12 number of mushrooms of *Lepiota humei* were found during the collection. The frequency of its presence was 33.33% and the density was 40%.



PLATE 20. *Lepiota humei*; Mature fruiting body, Cap (A), Gill (B), Spores (C).

4.17 Biodiversity, distribution and morphological characterization of *Clitocybe* sp.

4.17.1 *Clitocybe subconnexa*

Family:Tricholomataceae

Common name:None

Morphology of *Clitocybe subconnexa*

Clitocybe subconnexa fruit bodies was found on the soil of Sal forest, the color of the fruit bodies was creamy white in color. The shape of cap was convex and flat shaped and the cap margin was wavy but the cap surface was smooth. No scale was found on the cap. Regular shaped clustered gills was present underside of the cap and it was broadly attached to the stem. Stem was 2-8 cm long and 1.5 cm thick. Texture of the fruiting body was soft. Stipe was white in color. Ring or annulus was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore shape:Rounded, white in color, Single walled, smooth, spore size was 6.4×4.5 µm (Plate 21).

Habitat of *Clitocybe subconnexa*

The macrofungi was found on the soil of the Sal (*Shorea robusta*) tree of Sal forest. Average Relative Humidity was 72%, soil pH was 6 and soil type was loamy. Average recorded temperature was 24⁰C.

Biodiversity of *Clitocybe subconnexa*

Clitocybe subconnexa was found in the Sal forest region of Madhupur and Birganj Upazila of Tangail and Dinajpur District. Total 6 numbers of mushrooms of *Clitocybe subconnexa* were found during the collection. The frequency of its presence was 66.66% and the density was 20%.



PLATE 21. *Clitocybe subconnexa*; Mature fruiting body, Cap (A), Gill (B), Spores (C).

4.18 Biodiversity, distribution and morphological characterization of *Psathyrella* sp.

4.18.1 *Psathyrella candolleana*

Common name: Pale Brittle stem.

Family: Psathyrellaceae.

Morphology of *Psathyrella candolleana*

Psathyrella candolleana fruit bodies was found on the soil of the Sal forest, the color of the fruit bodies was dark brown color. The shape of cap was convex and the cap margin was very much round and the cap surface was smooth. No scale was found on the cap. Regular shaped crowded gills was present underside of the cap and it was brown color. Stem was present underside of the cap. Texture of the fruiting body was soft and spongy. Ring or annulus was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore shape: Rounded, brown in color, double walled, smooth, spore size was 6.6-7.8×4.5-5.8 μm (Plate 22).

Habitat of *Psathyrella candolleana*

The macrofungi was found on the soil of the Sal forest. Average Relative Humidity was 72%, soil pH was 6 and soil type was loamy. Average recorded temperature was 24°C.

Biodiversity of *Psathyrella candolleana*

Psathyrella candolleana was found in the Sal forest region of Birganj Upazila of Dinajpur District. Total ten numbers of mushrooms of *Psathyrella candolleana* were found during the collection. The frequency of its presence was 33.33% and the density was 33.33%.

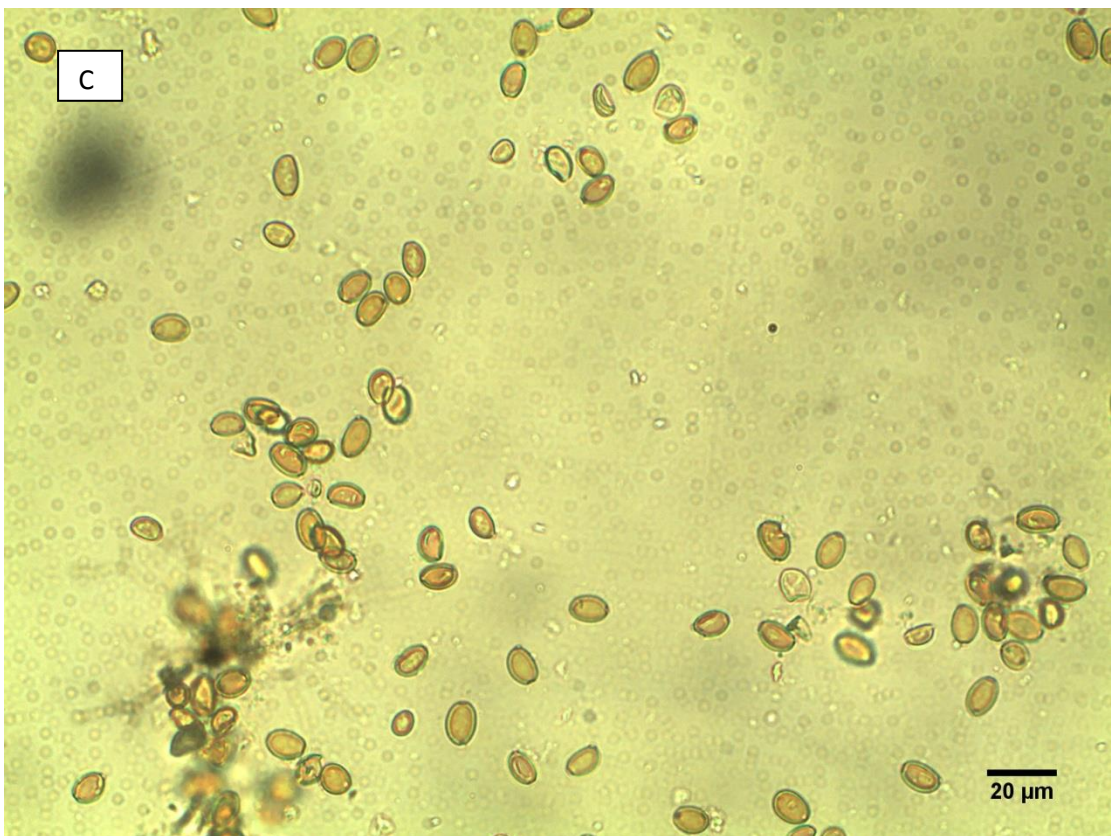
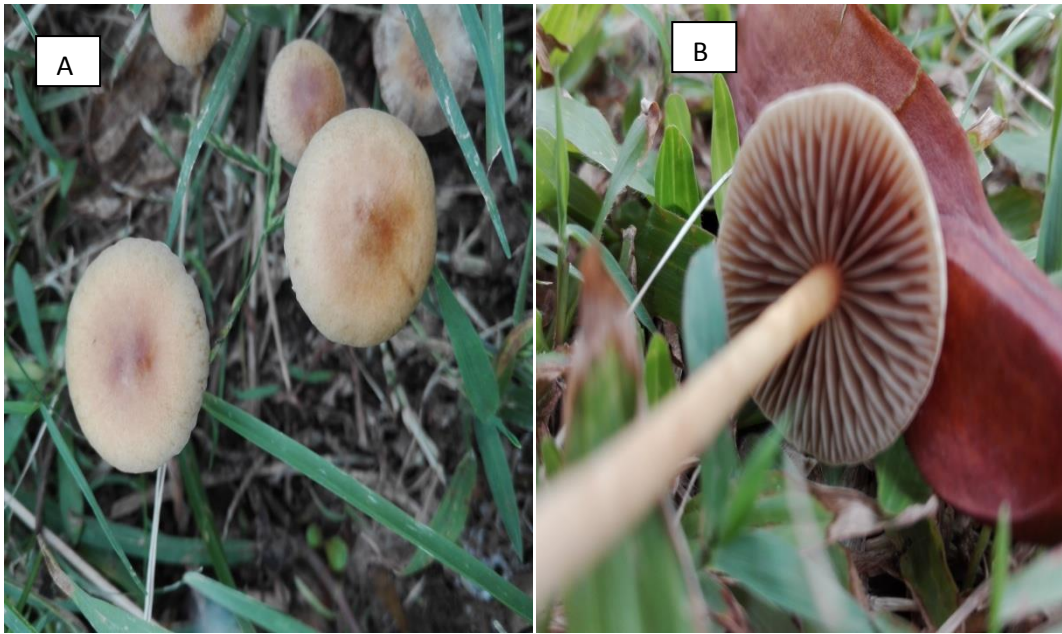


PLATE 22. *Psathyrella candolleana*; Mature fruiting body, Cap (A), Gill (B), Spores (C)

A survey was carried out in three Upazila namely Madhupur, Mithapukur and Birganj of Tangail, Rangpur and Dinajpur districts, respectively in the rainy season starting from July to October 2016 and 2017 to collect and study of the biodiversity, distribution and density of macrofungi population in the Sal forest regions of Bangladesh.

In the present study total 30 samples were collected and identified to 18 genera and 22 species under 12 families. Four species of *Ganoderma* were recorded in Birganj, Madhupur and Mithapukur Upazila under the Dinajpur, Tangail and Rangpur districts of Sal forest viz *Ganoderma lucidum*, *Ganoderma applanatum*, *Ganoderma tsugae* and *Ganoderma lipsiens*. These macrofungi were found on the (*Shorea robusta*) Sal tree. The frequency and density of these macrofungi were 33.33%, 100%, 100%, 33.33% and 16.66%, 50%, 33.33%, 53.33% respectively. The result of the present study was supported by Das *et al.*, 2017. They recorded *Ganoderma* spp. in Shamnagar Upazila in Satkhira district and Rampal Upazila of Bagerhat district of Bangladesh. These species were also reported from South Western region of Bangladesh (Rahaman *et al*, 2016). *Ganoderma applanatum*, *Ganoderma tsugae* and *Ganoderma lipsiens* were also reported from forest tree of National Botanical Garden, Dhaka. Among them *Ganoderma applanatum* were recorded in association with Golden shower (*Acacia auriculiformis*) and Neem (*Azadirachta indica*) tree (Rubina *et al*, 2017). These species were also reported from India (Pushpa *et al*, 2012). The basidiospore color and spore size of the collected *Ganoderma tsugae* was brown and 5.8-6.5 μm , *Ganoderma applanatum* was redish and 8.5x5-6 μm , *Ganoderma lucidum* was hyaline and 7.03x4.86 μm *Ganoderma lipsiense* was white and 6.4x4.5 μm respectively which was supported by Vyas, 2014. In a study of *Ganoderma tsugae*, Vyas (2014) found cinnamon brown colored basidiospore where the spore size was 1.5x1.5 μm that corroborates of our findings. The spore morphology of *Ganoderma* spp. in my study was also supported by Pushpa *et al.*, (2013).

Two species of *Agaricus* were recorded from Madhupur and Mithapukur of Tangail and Rangpur districts of Sal forest viz. *Agaricus* sp., *Agaricus campestris*. These macrofungi were found on the soil of the Sal tree (*Shorea*

robusta) with the frequency of 66.66% and 33.33% and density of 20% and 6.66% respectively. *Agaricus campestris* was also reported from south western region of Bangladesh (Rahaman *et al*, 2016) where it was associated with *Borassus flabellifer* tree, spore color and size was brown and 5x4.5 cm where in this study the macrofungi *Agaricus campestris* was associated with Sal (*Shorea robusta*) tree and color and spore size was brown and 6.2-3.8 µm. It was also reported from Mangrove forest region of Bangladesh and supported by (Das *et al*, 2017). *Agaricus campestris* was also reported from India (Pushpa *et al*, 2012). The findings of *Agaricus* sp. was reported from India (Mohanan, 2011; Thiribhuvanamala *et. al.*, 2011; Hansen, 1992).

Leucocoprinus birnbaumii was found from Mithapukur Upazila of Rangpur District Sal forest. It was found on soil beside Sal tree (*Shorea robusta*). The frequency and density of macrofungi was 33.33% and 36.66%. The spore color of collected macrofungi was brown and size of spore was 6-8x4.9-5.9 µm which supports with Mushroom Expert.com where spore color was brown and spore size was 7.5-11x5-6 µm.

Trametes versicolor was found from Madhupur Upazila of Tangail district Sal forest. It was found on dead bark of Sal tree. The frequency and density of macrofungi was 33.33% and 13.33%. *Trametes* sp. was found at Dinajpur district of the tropical moist deciduous forest region in Bangladesh (Rumainul *et al.*, 2015). The basidiospore color and spore size of collected *Trametes versicolor* was brown and 6.1x4.38 µm and in a study Rumainul (2015) found *Trametes versicolor* basidiospore color and size of spore was dark violet and 8.62x5.6 µm that corroborates the findings. It was first described by Elias Magnus Fries in 1835. This genus was also reported from India (Thiribhuvanamala *et al.*, 2011). *Trametes versicolor* was also found in Mongla, Rampal and Sarankhola Upazila of Bagerhat district (Das *et al.* 2017). *Trametes versicolor* declared as wood decaying fungi, collected from Dilla University, Ethiopia (Alemu, 2013).

Amanita bisporigera was found from Mithapukur and Madhupur of Rangpur and Tangail District. It was found on soil of Sal forest. The frequency and

density of macrofungi was 66.66% and 33.33%. *Amanita bisporigera* was recorded in sadar of Chuadanga district of south western region with a frequency and the density of 12.5% and 2.70%, respectively (Rahaman *et al*, 2016) . In this study it was found associated with Sal tree (*Shorea robusta*), basidiospore color and spore size was brown and 7-8x6-6.5 μm . The species *Amanita cinereovelata* was previously identified from Sal forest of Bangladesh (Hosen *et al.*, 2015).

Psathyrella candolleana was found from Birganj Upazila of Dinajpur District. It was found on soil of Sal forest. The frequency and density of macrofungi was 33.33% and 33.33%. Four species of *Psathyrella* sp. was recorded from Czech Republic and Slovakia (Vašutová *et al.*, 2008). A new species of *Psathyrella* (Psathyrellaceae, Agaricales) collected from Punjab, India (Kaur *et al.*, 2013). It was also reported from Forest tree of National Botanical Garden, Dhaka where it was found associated with White rangun (*Ixora superba*), (Rubina *et al*, 2017). In her study she found brown color basidiospore and 5.2x3.2 μm spore. But in this study it was found associated with Sal tree (*Shorea robusta*) and color of the spore was brown and size of spore was 6.6-7.8x4.5-5.8 μm which corroborates to (Rubina *et al*, 2017) findings.

Craterellus cornucopioides was found from Madhupur Upazila of Tangail District. It was found on Sal tree of Sal forest. The frequency and density of macrofungi was 33.33% and 50%. *Craterellus cornucopioides* was recorded from Daulatpur of Kushtia district in south western region with a frequency and the density of 12.5% and 2.70%, respectively (Rahaman *et al*, 2016). This species was found in association with *Cocos nucifera* (Rahaman *et al*, 2016), where the spore color was found creamy color and size of spore was 5x5 μm . But in this study it was found associated with Sal tree (*Shorea robusta*) and basidiospore color was hyaline and spore size was 2.6-3.4 μm which supports the (Rahaman *et al*, 2016) results.

Schizophyllum commune was found from Madhupur Upazila of Tangail district. It was found on dead bark of Sal tree of Sal forest. The frequency and

density of macrofungi was 33.33% and 30%. *Schizophyllum* sp. were found in Shyamnagar of Satkhira and Daulatpur of Kushtia district in association with *Ficus microcarpa* and *Artocarpus heterophyllus* (Rahaman *et al*, 2016), the findings of that study was supports with our findings where the color of spore was found brown and size of spore was found 7.6x4.99 μm .

Coprinus disseminates was found from Madhupur and Mithapukur Upazila of Tangail and Rangpur District. It was found on rotting Sal tree of Sal forest. The frequency and density of macrofungi was 66.66% and 56.66%. The spore color of *Coprinus disseminates* was found white and spore size was 3.4-5.5x2-3.5 μm . This *Coprinus* sp was found association with *Swietenia mahagoni*, from South western region of Bangladesh (Rahaman *et al*, 2016).

Lepiota humei was found from Mithapukur Upazila of Rangpur District. It was found on soil of Sal forest. The frequency and density of macrofungi was 33.33% and 40% and collected *Lepiota humei* spore color was brown and size of spore was 7.4x5.5 μm which was also reported in India (Kaur *et al*, 2014). Kaur *et al*, has given taxonomic description of these macrofungi.

Lepista sordida was found from Madhupur Upazila of Tangail District. It was found on bark of Sal tree of Sal forest. The frequency and density of macrofungi was 33.33% and 6.66%. The collected macrofungi spore color was brown and spore size was 7.3-8.8x5-7.5 μm which was supported by Mushroom Expert.com.

Polyporus sp. was found from Birganj Upazila of Dinajpur District. It was found on bark of Sal tree of Sal forest. The frequency and density of macrofungi was 33.33% and 16.66%. By using biotechnological methods, biodiversity of *Polyporus* sp. were collected and studied in Lagos State, Nigeria (Bankole *et al*, 2012).

Macrolepiota procera was found from Madhupur and Mithapukur upazila of Tangail and Rangpur District. It was found on soil of Sal forest. The frequency

and density of macrofungi was 66.66% and 46.66%. *Macrolepiota procera* taxonomy and biodiversity was also reported Amarkantak forest of Central India (Dwivedi *et al*, 2012). It was also found at tropical moist deciduous forest region in Bangladesh where spore color was found white and spore size was found 8.82x5.52 μm (Rumainul *et al.*, 2015) and the collected macrofungi spore color was found brown and spore size was 7.9-8.1x5-6 μm which supports (Rumainul *et al.*, 2015) results.

Clitocybe subconnexa was found from Madhupur and Birganj Upazila of Tangail and Dinajpur District. It was found on soil of Sal forest. The frequency and density of macrofungi was 66.66% and 20%. *Clitocybe spp.* is an edible macrofungi found from Europe, North America, Asia and Australia (Barros *et al*, 2008). *Clitocybe sp* was also reported from Ethiopia (Alemu, 2013).

Termitomyces heimii was found from Madhupur and Mithapukur Upazila of Tangail and Rangpur District. It was found on soil of Sal forest. The frequency and density of macrofungi was 66.66% and 23.33%. *Termitomyces sp.* was also found in India (Thiribhuvanamala *et al.*, 2011) *Termitomyces sp.* mushroom was studied at Gorakhpur forest division in India (Srivastava *et al.*, 2011). *Termitomyces sp.* was bounded by Roger Heim (Heim, 1942).

Laetiporus sulphurus was found from Madhupur Upazila of Tangail District. It was found on bark of Sal tree of Sal forest. The frequency and density of macrofungi was 33.33% and 13.33%. It was also reported from Navsari (South Gujarat), India (Chandulal *et al*, 2013). In a study (Chandulal *et al*, 2013) found spore color of *Laetiporus sulphurus* was yellow and size of spore was 6.4x4.5 μm . The collected *Laetiporus sulphurus* spore color was yellow and spore size was 4.5-4.9x3.5 μm which was corroborates with (Chandulal *et al*, 2013) findings.

Borofutus dhakanus was found from Birganj Upazila of Dinajpur District. It was found on soil of Sal forest. The frequency and density of macrofungi was 33.33% and 3.33%. The phylogenic, morphological and taxonomic

characteristics of *Borofutus*, under Boletaceae were previously described from Bangladesh (Hosen *et al.*, 2013).

Volvariella gloiocephala was found from Mithapukur Upazila of Rangpur District. It was found on soil beside Sal tree (*Shorea robusta*). The frequency and density of macrofungi was 33.33% and 23.33% and the size of the spore was 6-8 μm which was supported by (Rumainul *et al.*, 2015). *Volvariella* sp., were reported from Dhaka district of Bangladesh (Rumainul *et al.*, 2015). In a study (Rumainul *et al.*, 2015) found white color spore of *Volvariella gloiocephala* and 10.5x10.1 μm spore. These were also found in Sadar Upazila of Jessore, Sadar of Chuadanga, Koira of Khulna and Shaymnagar of Satkhira districts respectively (Rahaman *et al.*, 2016).

CHAPTER V

SUMMARY AND CONCLUSION

Biodiversity can be defined as totality of genes, species and ecosystem of a region. Generally, Macrofungi (Mushrooms) were found in forest area, on soil, on bark of tree and sometimes on wet land areas. Favorable environment such as soil condition, temperature, climatic condition was the possible reason for the growth and survival of various kinds of Mushrooms. Bangladesh has basically four types of forest.

A survey program was conducted in sal forest under tropical moist deciduous forest at three Upazila namely Birganj, Madhupur, Mithapukur under three Districts namely Dinajpur, Tangail and Rangpur respectively. In this survey 30 macrofungi samples were collected and identified to 22 species belonging to 18 genera and 12 families. The whole survey was mainly conducted at different Sal forest region of Bangladesh. So the macrofungi were basically associated with either the Sal tree or on the soil and rhizosphere of the Sal tree (*Shorea robusta*). The identified four species of *Ganoderma* were recorded as *Ganoderma* sp, *Ganoderma tsugae*, *Ganoderma applanatum*, *Ganoderma lipsiense*. Two species of *Agaricus* were *Agaricus* sp., *Agaricus campestris* and one species of each of *Amanita bisporigera*, *Macrolepiota procera*, *Clitocybe subconnexa*, *Coprinus disseminates*, *Schizophyllum commune*, *Lepiota humei*, *Leucocoprinus birnbaumii*, *Lepista sordida*, *Laetiporus sulphurus*, *Borofutus dhakanus*, *Craterellus cornucopioides*, *Volvariella gloiocephala*, *Psathyrella candolleana*, *Termitomyces heimii*, *Polyporus sulphurous*, *Trametes versicolor* were recorded. The highest frequency was 100% for *Ganoderma tsugae*, and *Ganoderma applanatum*, followed by 66.66% for *Agaricus* sp., *Amanita bisporigera*, *Macrolepiota procera*, *Clitocybe subconnexa*, *Coprinus disseminates* and *Termitomyces heimii* and then 33.33% for *Ganoderma lipsiense*, *Agaricus campestris*, *Psathyrella candolleana*, *Polyporus sulphurous*, *Trametes vesicolor*, *Ganoderma spp*, *Schizophyllum commune*, *Lepiota humei*, *Leucocoprinus birnbaumii*, *Lepista sordida*, *Laetiporus sulphurus*, *Borofutus dhakanus*, *Craterellus cornucopioides*, *Volvariella gloiocephala*. Highest density was

56.66% for *Coprinus disseminates*, 53.33% for *Ganoderma lipsiense*, 50% for *Craterellus cornucopioides* and *Ganoderma applanatum*, 46.66% for *Macrolepiota procera*, 40% for *Lepiota humei*, 36.66% for *Leucocoprinus birnbaumii*, 33.33% for *Psathyrella candolleana*, *Amanita bisporigera*, *Ganoderma tsugae*, 30% for *Schizophyllum commune*, 23.33% for *Termitomyces hemii* and *Volvariella gloiocephala*, 20% for *Clitocybe subconnexa* and *Agaricus spp.* The lowest density was 16.66% for *Polyporus sulphurous* and *Ganoderma spp.* 13.33% for *Trametes versicolor* and *Laetiporus sulphurus*, 6.66% for *Lepista sordida* and *Agaricus campestris*, 3.33% for *Borofutus dhakanus*. Among the total 22 species, highest 4 species were found under Agaricaceae and Ganodermataceae family. Then 3 species were found under Polyporaceae family. Two species were found under both of Psathyrellaceae and Tricholomataceae family and rest of the species were belongs to Amanitaceae, Schizophyllaceae, Lepiotaceae, Pluteaceae, Cantharellaceae, Lyophyllaceae and Boletaceae family. Through this survey it was proved that the Sal forest region of Bangladesh shows distinct biodiversity of macrofungi population.

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