

Diversity of Genus *Ganoderma* in Nagaon District, Assam

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Abstract: Nagaon district of Assam is located in the flood plains of the river Brahmaputra. The physiographic features of Nagaon District makes it ideal home for the growth of different types of economic plants. But these plants are found to be decayed by the association of some macro fungi. Among these macro fungi, different *Ganoderma* species were found to be associated with the different timber yielding plants and palm species. *Ganoderma* with great diversity produce large fruitification of different size, shape and colour. During the investigation 7 seven *Ganoderma* species were collected from 10 different Revenue Circles of Nagaon district. This work revealed that there are great diversity of *Ganoderma* species in Nagaon district, Assam. Some *Ganoderma* species have medicinal properties.

Keywords: *Ganoderma*, Nagaon district, timber yielding plants.

INTRODUCTION

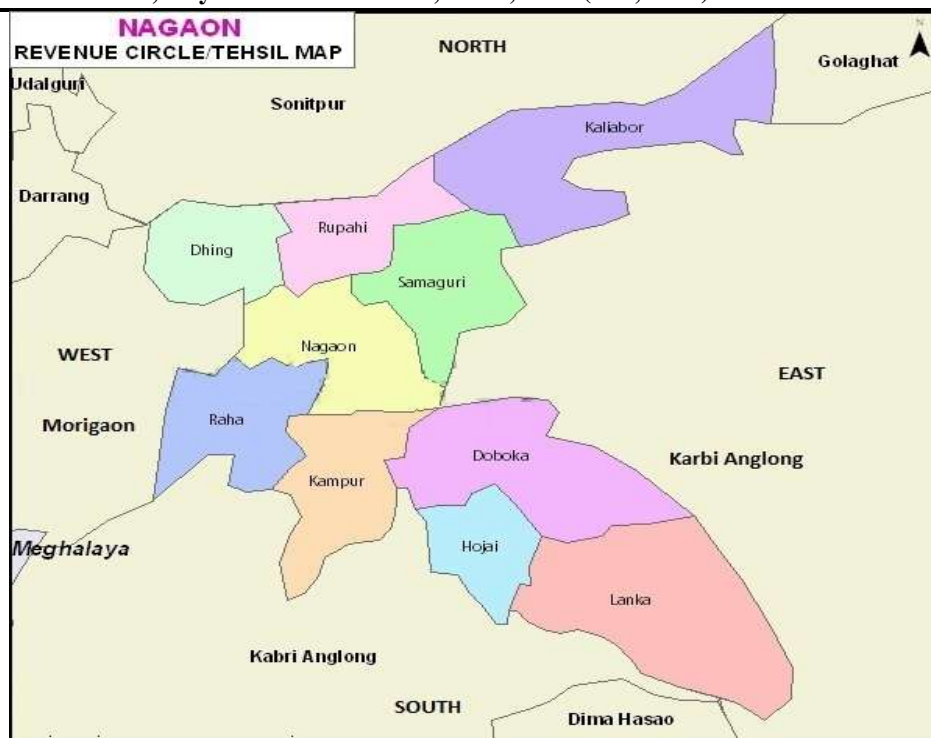
Wood inhabiting macro fungi draw attention from the mycologists along with the naturalists by their showy unique and different colours of fruiting bodies. Wood decaying Basidiomycetes colonize and degrade wood using enzymatic and non-enzymatic process. Once wood is attacked by the fungus, they will be destroyed unless proper treatments are done to control the fungus. Macro fungi with great diversity produce large frutifications of different size, shape and colour. Most macro fungi are saprobes, few mycorrhizal symbionts and some are parasitic [1]. The diversity of macro fungi in Nagaon District is yet to be explored. In this context an extensive survey was carried out in order to collect, identify and enumerate the different *Ganoderma* species in Nagaon District.

STUDY SITES

Nagaon District of Assam is located in the flood plains of the river Brahmaputra. The district is situated at 92° 41'29"E and 26°20'N, which covers a geographical area of 4,430.3 sq. km. Geography of this district is characterised by rivers, beels, marshy lands and highlands. On the North, Nagaon is bounded by the Brahmaputra and Sonitpur District. Towards the South lies west Karbi Anglong and Dima hasao. East Karbi Anglong and Golaghat District lies towards the East and West is bounded by Morigaon Dist. The altitude of the district is 60.4m. The monsoon last from April to June. The temperature in winter varies from a maximum of 24.8°C to a minimum of 11.2°C. In summer temperature varies from maximum 32.9°C to a minimum 29.5°C.

Study areas were divided into 10 Revenue circles of 3 Sub division (Nagaon, Kaliabor and Hojai) and samples were collected randomly from these revenue circles. The revenue circles were as follows:

1. Dhing circle.
2. Rupahi circle.
3. Kaliabor circle.
4. Samaguri circle.
5. Nagaon circle.
6. Dabaka circle.
7. Hojai circle.
8. Kampur circle.
9. Raha circle.
10. Lanka circle.



Map of Nagaon District

MATERIALS AND METHOD

Regular survey and collection of samples of fruit bodies of *Ganoderma* were carried out in different localities including forest areas of Nagaon during the period 2012-2015.

All the fruiting bodies were photographed in their natural habitat and then collected in cellophane bags after wrapping them in wax paper. Various parameters like habitat, size, shape, texture were considered. The identification of each sample were carried out with help of available literatures, and by studying different macro and micro-morphology Alexopoulos and Mims [2], Arora [3], Ellis and Ellis [4], Overholts [5], Philip [6], Else and Hans [7], Zoberi [8]. The samples were preserved in 4% formaldehyde solution and in 70-90% ethyl alcohol. All the specimens were also preserved in dry condition. Taxonomic Enumeration was done as per Ainsworth and Sussman [9].

RESULTS & DISCUSSIONS

During the investigation 7 (seven) *Ganoderma* species were collected from 10 different Revenue Circles of Nagaon district. This work revealed that there are great diversity of *Ganoderma* species in Nagaon district, Assam. Some *Ganoderma* species have medicinal properties. A taxonomic enumeration of the species is given below.

Order: Polyporales

Hymenium develops various way, fruiting body woody, leathery, resupinate, stipitate; hymenium ridged, sometimes spiny or worted.

Family: Ganodermataceae

Annual or perennial fungi ; basidia thinckened , pileus hard, crusty, wavy; spores zoned, ridged or grooved, coriaceous , context thick; pores minute to small; tube often stratified; no stipe , no veil and volva .

Ganoderma Karst. Emend. Pat

Fruiting body annual or perennial, single or in small groups ; shelf or bracket like, thick, tough or woody when dry ; upper surface hard, crusty, waxy and colour light brown to dark brown ; hymenium with tubes , pores minute to rarely visible ; no stipe, no veil ; basidiospores elliptical.

Ganoderma applantum (Pers.) Pat.

Sessile basidiocarp, corky or woody, applanate ; cap 4-55cm across, fan shaped, semi circular; brownish, upper surface dark brown to pale grey with concentric zonation; 3-5 tiny circular pore per mm, pores spherical or ovoid; no cystidia, hyphal system trimitic; basidiospores spherical to ovoid, measuring 5-7.8x5.5-6µm.

Ganoderma adpersum (Schultz.)Donk

Fruiting body perennial, hard, dark brown, bracket shaped, 11- 15cm across ; upper surface with concentrically ridged ; margin thick, obtuse ; flesh yellowish to dark brown; pores 3-4 per mm, spores round or ovate , 10-13 x 5.5-8 µm.

Ganoderma lucidum var *capens* (Curtis.) P. Karst.

Basidiocarp 7-10 x 10-17 x 1.3 cm, woody or corky, sub sessile ; upper surface dark red and yellowish towards margins, laccate ; pore surface cream coloured;

pores 4- 5 per mm ; hyphal system trimitic; basidiospores more or less round, 7.3-9 x 6.4 µm.

Ganoderma lucidum var lucidum (Curtis.) P.Karst.
Basidiocarp woody, laccate, laterally stipitate ; stipe reddish to blackish, 5-11 cm long ; upper surface pale grayish, radially sulcate ; pore surface whitish to yellowish; pore 3-5 per mm, round ; trimitic hyphal system.

Ganoderma resinaceum Boud
Poroid parasitic fungus persists throughout the years. Fruit body bright and shiny, large, 12-30 cm across, yellowish but it becomes black at maturity; yellowish

resins oozes out from the mature basidiocarp; spore print reddish brown; basidiospores ovoid to ellipsoid, smooth, measuring 8-10.5 x 4-6.5 µm .

Ganoderma testaceum (Lev.) Pat.Bull.
Sessile basidiocarp, sulcate upper surface ; pore surface whitish to yellowish , pores 3- 4 per

Ganoderma tsugae (Curtis.)P.Karst.
Saprobic, solitary ; cap 20- 25cm across, elongated and fan shaped with a shiny surface, reddish brown at maturity; stalk present ; pore surface white ; pores 4-6 per mm, flesh whitish; spores measuring 13 x 7.5µm, elliptical.

Table-1: Distribution of Ganoderma species in different revenue circles of Nagaon District.

Sl	Name of species	Dhing	Rupahi	Raha	Nagaon	Samaguri	Kaliabor	Kampur	Dabaka	Hojai	Lanka	Total revenue cycle of occurrence
1.	<i>Ganoderma adspersum</i> (Schulz.) Donk	-	-	-	+	-	+	-	-	-	+	3
2.	<i>Ganoderma applanatum</i> (Pers.) Pat.	+	+	+	+	+	+	+	+	+	+	10
3.	<i>Ganoderma lucidum</i> var. <i>capense</i> (Curtis.)P. Karst	+	-	+	+	-	+	+	-	+	-	6
4.	<i>Ganoderma lucidum</i> var <i>lucidum</i> (Curtis.) P. Karst	+	+	+	-	+	+	-	+	+	+	8
5.	<i>Ganoderma resinaceum</i> Boud	-	-	+	+	-	-	-	+	+	+	5
6.	<i>Ganoderma testaceum</i> (Lev.) Pat.Bull	-	-	-	+	-	-	+	+	-	-	3
7.	<i>Ganoderma tsugae</i> (Curtis.)P. Karst	-	-	-	-	-	+	-	-	-	-	1

The frequency of occurrence of Ganoderma species was recorded highest in *Ganoderma*

applanatum and lowest of frequency was recorded in *Ganoderma tsugae*.

Table-2: Frequency of occurrence of Ganoderma species

Sl. No	Name of Species	Family	Frequency
1.	<i>Ganoderma adspersum</i> (Schulz.)Donk	Ganodermataceae	30%
2.	<i>Ganoderma applanatum</i> (Pers.) Pat	Ganodermataceae	100%
3.	<i>Ganoderma lucidum</i> var. <i>capense</i> (Curtis.) P. Karst	Ganodermataceae	60%
4.	<i>Ganoderma lucidum</i> var <i>lucidum</i> (Curtis.) P. Karst	Ganodermataceae	80%
5.	<i>Ganoderma resinaceum</i> Boud	Ganodermataceae	50%
6.	<i>Ganoderma tsugae</i> (Curtis.) P. Karst	Ganodermataceae	10%
7.	<i>Ganoderma testaceum</i> (Lev.) Pat.Bull	Ganodermataceae	30%

Size and shape of basidia and basidiospores were recorded in Table-3 and it was found that Clavate

shaped basidia found in all the *Ganoderma* species. Basidiospores ranges from ovoid to elliptical.

Table-3: size and shape of basidia and basidiospores of collected specimens

Sl. No	Name of species	Size of basidia	Shape of basidia	Size of basidiospores	Shape of basidiospores
1	<i>Ganoderma adsperum</i> (Schulz.) Donk	9-11 x 9 µm	4 spored, clavate	10-13 x 5.5- 8 µm	Round or ovate
2	<i>Ganoderma applanatum</i> (Pers.) Pat.	9-12x10 µm	4 spored, clavate	7.3- 9 x 6.4 µm	Spherical to ovoid
3	<i>Ganoderma lucidum</i> var. <i>capense</i> (Curtis.) P. Karst.	12.5-13.5 x 8 µm	4 spored, clavate	7.3-9 x 6.4 µm	Round
4	<i>Ganoderma lucidum</i> var. <i>lucidum</i> (Curtis.) P. Karst	14 x 9 µm	4 spored, clavate	5-7 x 8.2 µm	Elliptical
5	<i>Ganoderma resinaceum</i> Boud	11-12.4 x 5-8.5	4 spored, clavate	8-10.5 x 4-6.5 µm	Ovoid to ellipsoid
6	<i>Ganoderma testaceum</i> (Lev.) Pat.,Bull	12-14 x 7.2 µm	4 spored, clavate	6-9.2x 6 µm	Ovoid
7	<i>Ganoderma tsugae</i> (Curtis.) P. Karst	11-13 x 6-8 µm	4 spored, clavate	13 x 7.5 µm	Elliptical

Odour of the collected sample was recorded and it was found that among 7 species, 6 were odourless. Spicy odour recorded in *G. resinaceum*. Reddish brown spore print was recorded in *G. resinaceum*. In chemical test with KOH, all species

turns black. Most of *Ganoderma* species were non-edible.

Among the seven species only two have medicinal value (Table-4).

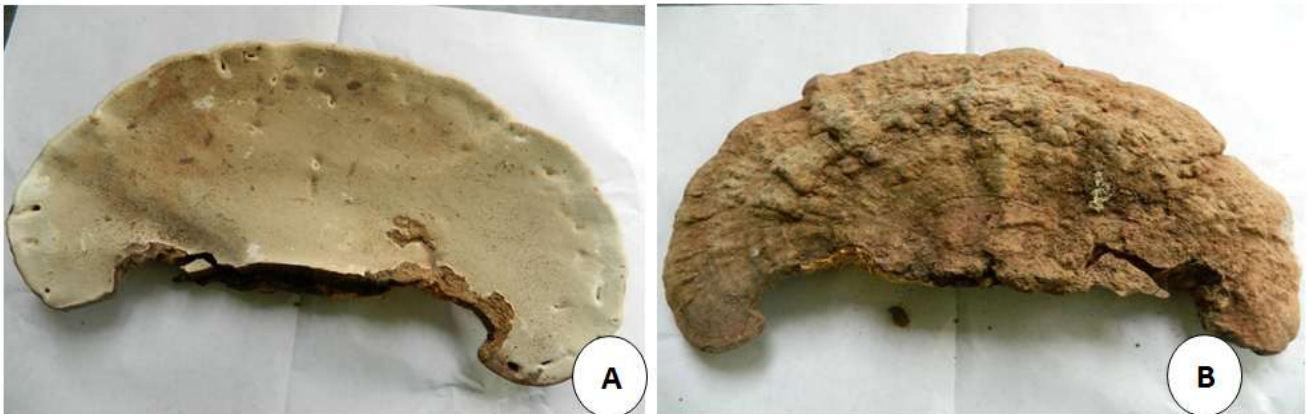
Table 4: odour, spore print and chemical test of collected *ganoderma* species

Sl. No	Name of macrofungi	Odour	Spore print	Chemical test
1	<i>Ganoderma adsperum</i> (Schulz.)Donk	Odourless	Not done	Flesh turns black with KOH reaction
2	<i>Ganoderma applanatum</i> (Pers.) Pat.	Odourless	Not done	Flesh turns black with KOH reaction
3	<i>Ganoderma lucidum</i> var. <i>capense</i> (Curtis.)P. Karst.	Odourless	Not done	Surface turns black with KOH
4	<i>Ganoderma lucidum</i> var. <i>lucidum</i> (Curtis.) P. Karst	odourless	Not done	Surface turns black with KOH
5	<i>Ganoderma resinaceum</i> Boud	Spicy Odour and bitter test	Reddish brown	Surface turns black with KOH
6	<i>Ganoderma testaceum</i> (Lev.) Pat.Bull	Odourless	Not done	Surface turns blacks with KOH
7	<i>Ganoderma tsugae</i> (Curtis.)P. Kar	Odourless	Not done	Surface turns black with KOH

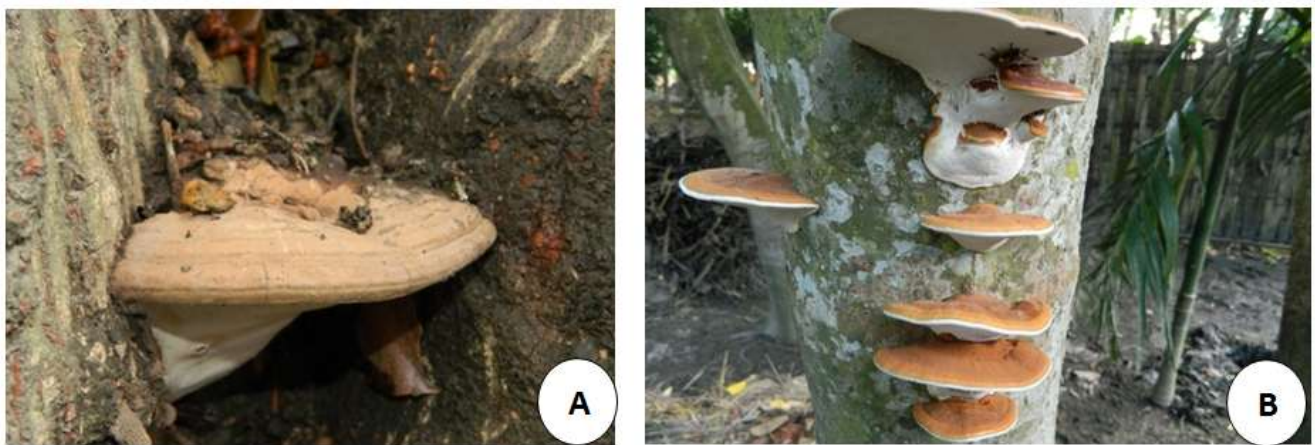
Table-5: MEDICINAL OTHER USES

Sl	Name of macrofungi	Medicinal uses	Other importance
1	<i>Ganoderma adsperum</i> (Schulz.)Donk	-	Non edible
2	<i>Ganoderma applanatum</i> (Pers.) Pat	Medicinal	Non edible
3	<i>Ganoderma lucidum</i> var. <i>capense</i> (Curtis.) P. Karst	-	Non edible
4	<i>Ganoderma lucidum</i> var. <i>lucidum</i> (Curtis.) P. Karst	Medicinal	Non edible
5	<i>Ganoderma resinaceum</i> Boud.	-	Non edible
6	<i>Ganoderma testaceum</i> (Lev.) Pat. Bull	-	Non edible
7	<i>Ganoderma tsugae</i> (Curtis.) P. Karst	-	Non edible

PHOTOGRAPHS OF *GENODERMA*



Ganoderma adsperum (Schulz.) Donk: A. Upper surface B. Lower Surface



A & B. *Ganoderma applanatum* (Pers.) Pat: with substratum



A. *Ganoderma lucidum* var. *capense* (Curtis.) P. Karst



A. *Ganoderma lucidum* var *lucidum* (Curtis.) P. Karst;



B. *Ganoderma lucidum* var. *lucidum*



B. *Ganoderma resinaceum* Boud.



Ganoderma testaceum (Lev.) Pat. Bull A. upper surface, B. Lower surface



Ganoderma tsugae (Curtis) P. Kar: A. Upper surface B. Lower surface

CONCLUSION

The exploration and documentation of wood decaying basidiomycetes is a time consuming affair. Very scanty information about wood decaying basidiomycetes was available in Nagaon district, Assam. Moreover, no any published monographs or list of wood decaying basidiomycetes from this region are available. In the present work, wood decaying *Ganoderma* species were collected from 10 revenue circles of Nagaon district and preserved. Total 7 species were identified. Frequency of *Ganoderma* species in study area was recorded and *Ganoderma applanatum* (Pers.) Pat was found to be the highest percentage. Maximum number of species was collected from dead wood logs followed by decaying wood and living trees. The present study reveals that sap wood is more susceptible than the heart wood.

Among the studied samples, 2 species were used as medicine. The occurrence and distribution of wood inhabiting *Ganoderma* are influenced by prevailing environmental condition and the availability of host or substrata. Present study reveals that edaphic

condition has influence on distribution of wood decaying basidiomycetes and found that soil fertility has great influence on the abundance and diversity of wood decaying basidiomycetes. Climatic changes and reduction of forest cover are responsible for gradual reduction of macrofungal species.

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