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Environmental Pollution Due To Airborne Microbes

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Abstract -

Thirty six different fungal spores were isolated and identified in the study carried out at different sites of Soalkuchi, a silk village of Assam. The yield of spores from market area was the highest followed by weavers' house. The count was highest in August, September and October and lowest in January. Temperature had little effect of concentration of various spores types whereas the rainfall showed the direct relationship with spore concentration. ***Aspergillus***, ***Cladosporium***, ***Curvularia***, ***Penicillium***, ***Fusarium***, ***Alternaria***, ***Mucor***, ***Helminthosporium*** spores were observed throughout the year at all sites. ***Aspergillus*** was the dominant type. The airborne fungal spores play an important role in allergic disorders. The record of airmicroflora is very helpful for the diagnosis and treatment of allergic disorders. The airborne microbes cause the biodeterioration of the environment.

Introduction : -

Aerobiology has developed into an expanding science with interdisciplinary boarders extending to plant pathology, mycology, palynology, biodeterioration and allergy. The aerobiological investigations of the outdoor atmosphere involve in the experiments conducted for the detection of the aero allergenic fungal spores, which have their impact on human health as a part of the general aerobiological experiments. The study of aerobiology has its bearing on various areas of human health and welfare, among which may be mentioned allergy and plant pathogenicity, involving spores which subjected matter of the present investigation. Airborne fungal has been widely considered as major allergens capable of causing asthma, allergic rhinitis and other allergic diseases (Barua, 1961). Diversity of topography, variance

of meteorological and climate condition from place to place is highly reflected in the incident of aero allergens (Blode, 1978).

The present investigation was undertaken to study the incidence and frequency of airborne fungal spores over some selected sites at Sualkuchi, Kamrup district, Assam for a period of twelve months and effect of the meteorological parameters on the prevalence of the airborne fungal spores. Sualkuchi which is known as "Manchester of East" is a famouse place for production of "Paat and Muga" (Assam silk) clothes. Sualkuchi is not famous for production of golden silk, but also it is famous for the high density of population compared to other villages. The selected sites are market areas and weavers houses. The pathogenic forms of microbe may cause allergy along with other ailments. So we have considered to study the role of fungal population and its relevance in human health hazard and biodeterioration of the environment.

Materials and Methods : -

Air sampling was conducted over the sites with the help of Burkard Personal Sampler at ten days interval throughout the year (January to December, 2013). The sampler was placed at a height of 5 ft. above the ground level. It was operated for 5 mins. Exposures are made thrice a day --morning, midday and evening. After its exposure, the slide was examined under the microscope. The identification are based on the colour, size, shape of spore and other important diagnostic features. Spores types are identified upto genus. The identification of the fungal spores was done with the help of published literatures. (Funder 1953, Gilman 1959, Tilak 1989, Nair 1986).

Results and Discussions : -

The number of fungal spore varied in the two sites. 29 different varieties have been recorded from weavers house and 36 varieties from market area. Highest number of fungal spores were counted from market area. The most frequently occurred spore type which eventually contributed to the total airspora were ***Aspergillus*** sp. (21.74%), ***Cladosporium*** sp. (16.43%), *Curvularia* sp. (12.13%), ***Penicillium*** sp. (10.39%), *Furarium* sp. (8.52%), *Alternaria* sp. (8%), ***Mucor*** sp. (7.89), ***Helminthosporium*** sp. (6.52%) etc. Among all these ***Aspergillus*** sp. was found to be the most dominant spore on the air over the two sampling sites. Konger and Barua (1958), Barua (1961), Barua and Chettia(1966), Singh (1985), Sarma and Sarma (1993), Mazumdar and Bhattachajya (2000) had reported similarly.

During the month of August, September and October, the maximum spore count were recorded. This period was seen to the most favourable for growth of variety of microfungi. The minimum number of the fungal types were recorded during the month of January. Temperature had little effect of concentration of various spore types

as where the rainfall showed the direct relationship of the spore concentration.

Table : Showing the Concentration of different Airborne Fungal spores using Burkard Personal Sampler.

		Weavers' House	Weavers' House	Market Area	Market Area
Sl. No.	Fungal Spores	Total number of spores	P.C. of total occurrence	Total number of spores	P.C. of total occurrence
1.	***Aspergillus*** sp.	550	21.15	716	12.17
2.	***Alternaria*** sp.	166	6.39	426	7.24
3.	***Bispora sp.***	56	2.15	8	0.14
4.	***Botrytis sp.***	98	3.77	62	1.05
5.	***Cercospora sp.***	52	2.00	16	0.27
6.	***Chaetomium sp.***	-	-	105	1.76
7.	***Cladosporium sp.***	402	15.46	618	10.51
8.	***Corynespora sp.***	18	0.69	10	0.17
9.	***Curvularia sp.***	136	5.23	470	7.99
10.	***Drechslera sp.***	76	2.92	126	2.14
11.	***Epicoccum sp.***	4	0.15	6	0.10
12.	***Fusarium sp.***	148	5.69	466	7.92
13.	***Ganoderma sp.***	-	-	18	0.31
14.	***Helminthosporium sp.***	60	2.31	452	7.68
15.	***Heretosporium sp.***	4	0.15	4	0.07
16.	***Lacellina sp.***	10	0.38	12	0.20
17.	***Leptospeaeria sp.***	-	-	96	1.63
18.	***Melanospora sp.***	-	-	6	0.10
19.	***Monilia sp.***	-	-	10	0.17
20.	***Mucor sp.***	138	5.31	464	7.89
21.	***Myrothecium sp.***	20	0.7	4	0.07
22.	***Nigrospora sp.***	92	3.54	524	8.91
23.	***Penicillium sp.***	122	4.69	512	8.70
24.	***Periconia sp.***	54	2.08	14	0.24
25.	***Pithomyces sp.***	28	1.08	8	0.14
26.	***Pyricularia sp.***	46	1.77	34	0.58
27.	***Pestalotia sp.***	-	-	20	0.34
28.	***Rhizopus sp.***	62	2.38	40	0.68
29.	***Sporidesmium sp.***	18	0.69	186	3.16
30.	***Stachybotrys sp.***	18	0.69	12	0.20
31.	***Tetraploa sp.***	18	0.69	14	0.41
32.	***Tetracoccosporium sp.***	-	-	20	0.34
33.	***Trichoconis sp.***	6	0.17	8	0.14
34.	***Trichoderma sp.***	120	3.33	334	5.68

35.	***Trichothecium sp.***	20	0.56	0	0
36.	***Torula sp.***	14	0.39	6	0.10

The investigation of aerobiology is important in the pathogens of respiratory allergic diseases in human beings. Allergic Bronchiopulmonary ***Aspergillosis*** is the most frequently recognised disease causes by ***Aspergillus*** sp. The aerospora causes the biodeterioration of the environments. The bioparticles are present inside the buildings such as homes, schools, collages, library, hospitals, industries, warehouses, cattle sheds, caves and other working environments. The contamination of the indoor environment with the presence of microbial populatin and other contaminants certainly possess a major health hazards problems.

Biodeterioration is an entirely different and new field of aerobiology in which the substrate, the organism and the environment interact. The analysis of total population, frequency and abundance of micro flora during manufacturing, packing, storage and transit is necessary. Microbial deterioration of papers like book archival material, manuscripts, decorative wall paper cloth is a serious problem throughout the world in museums, libraries, archives etc. where these materials are placed.

The high percentage of ***Aspergillus*** (21.15%) and ***Cladosporium*** (15.46%) observed in the present studies are important from allergic point of view. Aspergillus is mostly saprophytic. It is highly allergic and biodeteriorating agent. ***Aspergillus*** spp. are involved in a variety of clinical conditions in human of which Aspergillus fumigatus, ***Aspergillus*** flavus and ***Aspergillus*** niger are important. Allergic BronchiopulmonaryAspergillosis (A. B. P. A) is immunologically complex disease with symptoms very similar to tuberculosis. Fungal infections are most commonly seen in the patients suffering from AIDS.

Cladosporium is also one of the main component of airborne biota causing the biopollution. Spores of this genus constitute predominant type of airspora and have been found to be reported throughout the world and this fungus is also important from allergic point of view. The species of ***Penicillium*** is also important from allergic point of view. Many fungi are responsible for the diseases of human beings. Some of the serious diseases of human beings e.g. the disease of skin, ear, throat, nose and as well as bronchial and intestinal disorders are caused by various groups of fungi. Many species of ***Fusarium***, ***Mucor***, ***PenicilliumAspergillus***, ***Cladosporium*** etc. produce toxin called aflatoxins while growing on improperly stored grains and seeds. When such contaminant seeds and grains are consumed by animal and human beings, they cause serious diseases including liver cancer.

Some species of ***Mucor*** and Rhizopus cause fungal diseases of animals

and man (known as ***Mucor***mucosis) they attack the internal nervous system with fatal consequences. ***Mucor***mycosis seems to be frequent in patients suffering from diabetes, leukaemia and cancer.

Spores of the fungus namely ***Aspergillus***, ***Cladosporium***, ***PenicilliumAlternaria***, ***Fusarium*** and Rhizopus are responsible for biodeterioration. The process of biodeterioration is hasten due to the excessive humidity and poor ventilation. This is a correlation between microbes and environmental conditions, that lead to biodeterioration of the surrounding environment.

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Ethnobotanical Study Of Borduar Reserve Forest Of Kamrup District Used By Tea-Garden Communities

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Introduction :- Plants are the basis of the life on earth and are central to peoples livelihood. Tribal people are the ecosystem people who live in harmony with the nature and maintain a close link between man and environment. The human use of plant as a source of medicine according to its needs. Some beneficial, some harmful and some toxic. The present study aim to enumerate the ethomedicinal aspects of the tea-garden communities with an aim to add information to strengthen the resource on medicine multi-disciplinary study involving the relationship between plant and aboriginal people at a fair familiarity with flora of the vegetation of the Region.

North-eastern India offers an immerse scope for such ethnobotanical studies since it is mostly inhabited by numerous aboriginal tribes having rich folklore. Assam resides in remote areas and is totally dependent on plants for their day today life. Not only for food, fodder, cloths, house making but their medical requisites are also fulfilled by the wild plant growing in vicinity. Plants are used in many ways including worshipping, Gods and Goddesses for Ethnobotany explore how plants are used for such things as food, shelter medicine, hunting, religious ceremonies.

The present paper has been undertaken with an attempt to collect and study of plant species of Borduar reserve forest of Kamrup district.

Ethnobotany deals with relationship between plants and human beings and by ethnobotanical approach to a flora we can expect to achieve certain other objectives (i) Plant involved in material culture of the people (ii) Plant associated with their ceremonies, beliefs etc. (iii) Local names of plants.

The study area of Borduar reserve forest of Kamrup district covering an area

of 3617.96 hector and extending from $25^{0}43/$ to $26^{0}51$N latitude and between $90^{0}36/$ $92^{0}12/$ longitude.

The Brahmaputra river bound it on north, Maghalaya state bound on South, Rani reserve forest bound on the east, Kulchi reserve forest bound on the west division of Borduar reserve forest of Kamrup district.

The total population of Borduar reserve of tea-garden communities is 550.

Method of Study :- The present work is based carefully planned intensive survey and field studies conducted during 2013 in Borduar Reserve Forest and the villages inhabited by tea-garden community of Kamrup district in Assam. The plant specimen as reported by the village people as medicinal and other plants are collected from different experiment sites. The aim of this study is to know the plants use by the tea-garden and ex-tea garden communities of Borduar Reserve Forest of Kamrup district and to record the new and the less known uses of plant of them.

The survey was conducted in following forest Khirkijuli village, Borjar villages, Puranline village.

Result and Discussion :-

Plants used in Religious ceremonies and Festivals :- "Karam Puja" is the chief festival of tea-garden people. The festival is observed during August-Sept at last 5 days. Other common festivals are Tulsi Puja, Sarrai Parab also known as Garay paras on Kali Puja, Gram Puja, Phakua Puja, Cherul Puja, Durga Puja, Ganesh Puja etc. The plant specimen which used in Religious ceremonies are discuss in **Table –I.**

Table –I

Sl. No	Local Name	Botanical Name	Family	Nature	Uses
1	Tora	*Alpinia nigra*	*Zingiberaceae*	Wild	In the ritual of purification the eatables are offered on leaves with a belief that the child never suffer any physical disability
2	Tamul	*Areca Catechu*	*Arecaceae*	Wild	Areca nut and betel leaf are indispensable in almost all the religious ceremonies and social oceasion
3	Marapat	*Corchorus eapsularis*	*Tliaceae*	Wild	The jute are used to garland the cattle in the charal puja
4	Haldi	*Curcuma longa*	*Zingberaceae*	Wild	Used for ceremonial both on all social and religious oceasions.
5	Bengana	*Solanum melongena*	Solanaceae	Wild	Fruits are used to make chat in spring festival.

The house where a birth takes place is considered untouchable for a few days. In local language such a period is known as chuwa. On the ninth day of the birth the house held observed sasthi and a stone is normally workshipped as s symbol of goddess. Both the laughter and cry of the new born is considered as the handiwork of the goddess. On the ninety day the family barder does the works like hair trimming and nail cutting as a part of chati-ritual. In case of nail cutting by women folk the ritual is known as Nokh-Tunga. The little bit of the several hairs of the new born are tied in a pieces of banana leaf and buried under nearly bamboo bush.

Last Rites :- In case of death due to snake-bite minor's death and death of a pregnant women the community record to burial. Usually the deceased in given a bath and covered with a white cloth with the help of the relatives and neighbors the deceased is carried to the burial ground. On way Akhoi Mustard seed in thrown by uttering "Haribol". The fire candle is prepared by using either branches of Bel or Mango Tree, on way to the burial ground a branch of any spiny tree is fixed to the ground over which everyone has to jump over. This activity form a part of the ritual.

After cremation all the persons take bath and assemble in the house of the deceased. As a part of the purification rite assembled ones are sprinkled with tulsi water.

Edible Plants :- The forest supply a wide variety of wild food plants. Many of such plant not only yield fruits but also produce vegetables. The plant species which used tea-garden communities as a food plant are discuss

able –II

Sl. No	Local Name	*Botanical Name*	*Family*	Nature	Uses
1	Ata phol	*Ananas Squomosa*	*Annonaceae*	Wild	Ripe fruits are taken .
2	Kothal	*Artocarpus heterophyllus*	*Moraceae*	Wild	Fruits are taken .
3	Bel	*Aegle marmelos*	*Rutaceae*	Wild	Fruits are taken raw
4	Kordoi	*Averrhoea carambola*	*Averrhoaceae*	Wild	Used a vegetables
5	Bonoria Ada	*Amomum dealbatum*	*Zingiberaceae*	Wild	Rhizomes are used in curry and vegetables
7	Jati Bahn	*Bambusa tulda*	*Poaceae*	Wild	The young shoot in taken food.
8	Kamora	*Cucurbita pepo*	*Cucurbitaceae*	Cultivated	Used as vegetables
9	Ranalow	*Cucursita maxima*	*Cucurbitaceae*	Cultivated	Used as vegetables
10		*Cucumis alivus*	*Cucurbitaceae*	Cultivated	Used as vegetables
11	Coffea	*Coffea arabice*	*Rubiacece*	Cultivated	Used as refreshment drink.

12	Tarmuge	*Citrolus vulgaris*	*Cucurbitaceae*	Cultivatad	Fruits are taken
13	Dania	*Coriandrum sativum*	*Cembelliferae*	Cultivated	Use as vegetables
14	Nemu	*Citrus limelta*	*Rutaceae*	Cultivated	Fruits are taken
15	Rabab tenga	*Citrus decumana*	*Rutaceae*	Wild	Fruits are taken
16	Omita	*Caria papaya*	*Rutaceae*	Wild	Ripe fruits are taken raw
17	Bonoria Kachu	*Colocasia antiguarum*	*Araceae*	Wild	Leaf are eaten and taken
18	Tezpat	*Cinnamonum tamale*	*lauraceae*	Wild	Leaf are used in curry
19	Gajor	*Daucus carota*	*Apiaceae*	Cultivated	Fruits are used
20	Kath alu	*Dioscorea bulbefera*	*Dioscoreaceae*	Wild	Under taken roots and as used vegetables.
21	Gas alu	*Dioscorea heniltonii*	*Discoreaceae*	Wild	Root and used as vegetables
22	Outenga	*Dillenia indica*	*Dillenniaceae*	Wild	Used as vegetables
23	Urahi	*Dolichos lablab*	Papilionaceae	Wild	Used as vegetables
24	Helenchi	*Enhydra fluctuans*	Asteraceae	Wild	Leaves are used
25	Jam	*Eugenia jambolana*	*Myrtaceae*	Wild	Fruits are eaten .
26	Amlakhi	*Emblica officianates*	*Euphorbiaceae*	Wild	Fruits are eaten .
27	Gamari	*Gmelina arborea*	*Verbenaceae*	Wild	The flower are used as vegetables
28	Manimuni	*Hydrocotyle asiatica*	*Umbiliferaece*	Wild	Leaves one and as vegetables
29	Vandi	*Hibicus esculentus*	*Malvaceae*	Cultivated	Fruits are used as vegetables
30	Kolmou	*Impomoea acquatica*	*Convolvulaceae*	Wild	Fruits are used as vegetables
31	Dron	*Leucus aspera*	*Laminaceae*	Wild	Leaves are used vegetables
32	Jatilow	*Lageveria vulgaris*	*Cucurbitaceae*	Cultivated	Fruit are used as vegetables
33	Vol	*L. cylindrical*	*Cucurbitaceae*	Wild	Fruits are taken as vegetables

34	Lesu	*Litchi sinensis*	*Sapindaceae*	Wild	Ripe fruits are eaten
35	Bhim kol	*Musa balsiciane*	*Musaceae*	Wild	Ripe fruits are taken.
36	Sojna	*Moringa oleifera*	*Moringaceae*	Wild	The flower are used as vegetables
37	Poduna	*Mentha arvensis*	*Laminaceae*	Wild	Leaves are used as vegetables.
38	Tita kakiral	*Monordica charantia*	*Cucurbitaceae*	Wild	Fruits are eaten
39	Khejur	*Phoenix daetylifera*	*Aracaceae*	Wild	Ripe fruits are taken
40	Horpholi	*Phyllanthus acidus*	*Euphorbiaceae*	Wild	Fruits are taken raw
41	Maduriam	*Psidium guajava*	*Myrtaceae*	Wild	Fruits are taken .
42	Amra	*Terminalia tomentosa*	*Combrataceae*	Wild	Fruits are taken
43	Tetle	*Temarindus indica*	*Fabaceae*	Wild	Fruits are taken
44	Alu	*Solanum tubersum*	*Solenaceae*	Cultivated	Used as vegetables
45	Bengena	*S. melogera*	*Solenaceae*	Cultivated	Used as vegetables
46	Biliahi	*S. lycoporsicum*	*Solenaceae*	Cultivated	Used as vegetables
47	Bogori	*Ziziphus jujube*	*Khamnaceae*	Wild	Fruit are eaten raw
48	Bhol	*Luffa cylindrical*	*Cucursitceae*	Wild	Fruit are cooked and taken as vegetables
49	Ananas	*Ananas comosus*	*Bromeliaceae*	Wild	Shoots and leaves are used as vegetables
50	Haldi	*Curcuma domestica*	*Zingiberaceae*	Wild	Rhizome are used in curry vegetables.

Medicinal Plant :- Ethnobotany is the inter-relationship between people plant of on area which they exist. Large number of plant is used by the local people for treatment of their aliments. Forest are very rich in wild medicinal plants. A list of medicinal plant used to tea-garden community are discuss **Table –III**

Sl. No	Local Name	*Botanical Name*	*Family*	Nature	Uses
1	Latumoni Lata	*Abrus precatorus*	*Fabaceae*	Wild	Root used in diarrhea, dysentery
2	Bel	*Aegel marmelose*	*Rutaceae*		Unripe fruits are used in dysentery
3	Manimoni	*Centacella asiatica*	*Apiaceae*	Wild	Plant is used for women after child birth used in chronic dysentery as antiseptic in wounds
4	Kona simulu	*Commelina diffusa*	*Commelinaceae*	Wild	To stop bleeding of wounds/cuts
5	Dubari bon	*Cynodon dactylon*	*Poaceae*	Wild	Used in treatment of piles
6	Ghah bon	*Cyperus aromaticus*	*Cyperaceae*	Wild	Tubers are used in skin disease
7	Keya bon	*Cyperus rotundus*	*Cyperaceae*	Wild	Tubers paste is used a appetizer
8	Helonchi sak	*Enhydra fluctuans*	*Asteraceae*	Wild	Plant is used in gonorrhea
9	Saru manimuni	*Hydrocotyle javanica*	*Apiaceae*	Wild	Used in amoebic dysentery
10	Kalmou	*Ipomea aqnatica*	*Convolvalaceae*	Wild	Leaf extras to centred bleeding during child birth
11	Pani khuture	*Ludwigia adscenelens*	*Onagraceae*	Wild	Used as antiseptic dysentery
12	Mati kaduri	*Alternanthera sessilis*	*Amaranthaceae*	Wild	Shoot and leaf used in dysentery
13	Lata guti	*Caesalpinia bondweek*	*Caesalpineas*	Wild	used in dysentery
14	Sambong	*Blumea balsamifera*	*Asteraceae*	Wild	Used in gastric problem
15	Pashtia	*Vitex negundo*	*Verbenaceae*	Wild	Used in tonsillitis
16	Sonaru	*Cassia fistule*	*Caeslpinaceae*	Wild	Used in indigestion
17	Podume	*Mentha arvensis*		Wild	Indigestion
18	Vote Ara	*Jatropha curcus*	*Euphorbiceae*	Wild	Used in piles
19	Karabi	*Neruim odorum*		Wild	Skin disease ulcer, Ring worms
20	Bogagire	*Ferulla asafoteda*	*Umbeliferae*	Wild	Diabetes, Heart problems
22	Dhania	*Coriandrum salivum*	*Umbelliferae*	Wild	Swelling, Diarrhea
23	Omita	*Carica papaya*	*Anaemia jaundice*	Wild	Muscle pain.
24	Tioh	*Cucumis salivus*			Dry skin

25	Tulsi	*Ocimum sanetum*	*Haminaceae*	Wild	King worm whooping cough
26	Ara gas	*Ricinus communis*	*Euphorbiaceae*	Wild	Dry skin, Eye disease
27	Tengeshi	*Onalis corniculate*	*Oxalidaceae*	Wild	Dysentery, blood dysentery ad liver disorder.
28	Podum Phol	*Nelumbo nucifera*	*Nelumbonaceae*	Wild	Used for cardiac treatment
29	Punijalokia	*Ludwigia Octavalvis*	*Onagraceae*	Wild	Used in intestine worm, used in dysentery and fever.
30	Tora	*Alpinia nigra*	*Zingioberaceae*	Wild	Rhizome is used vermifuge to children.
31	Boch	*Acorus calamius*	*Araceae*	Wild	Used in this treatment of cough, asthma of the children.
32	Thekra	*Garcinia Pedunculata*	*Guttiferaceae*	Wild	Blood dysentery
33	Chirate tite	*Swertia chirate*	*Gentianceae*	Wild	Fever, indigestion, skin disceae.
34	Pan	*Piper betel*	*Piperaceae*	Wild	leaf is used in headache
35	Joba phol	*Hibiscus rosa sinensis*	*Malvaceae*	Wild	Used in heart problem

Socia Religious aspects :- There are certain plant associated with their religious and social customs and belief and thus help in maintaining the cultural aspect of the society. In the present category all plant involved directly or indirectly in religious rituals and belief, social customs and festivals have been included. The most significant in this connection that certain plant viz ocimum sanctum, Areca-catechu, phrymum pubinerve and piper betel are indispensable in all most all the religious and social function.

Construction :- The construction pattern is very simple and it is rectangular shape. Building material required are first collected. The posts are selected from durable timbers on bamboo. A list of plants used in house building by the tea-garden communities are given below **Table –IV**

Sl. No	Local Name	*Botanical Name*	*Family*	Nature	Uses
1	Areca Catechu	Areca Catechu	*Arecaceae*	Wild	Stems are used for temporally house posts
2	Kathal	*Artocarpus heterophyllus*	*Moracceae*	Wild	Posts, beams, planks etc.
3	Gargane	*Dipterocarpus macrocarpus*	*Dipterocarpaceae*	Wild	Posts ,beams, planks
4	Nahal	*Mesua ferrea*	*Calophyllaceae*	Wild	Posts ,beam ,planks
5	Tita sapa	*Michelia champoca*	*Magnoliaceae*	Wild	Posts, planks, door, panels, window.

6	Sal	*Shorea robusta*	*Diptercorpaceae*	Wild	Posts, beams, planks
7	Poma	*Cedrela toona*	*Meliaceae*	Wild	Posts beams, planks

Miscelleneous uses of Plants :-

Sl. No	Local Name	*Botanical Name*	*Family*	Nature	Uses
1	Kathal	*Artocarpus heterophyllus*	*Moracceae*	Wild	Latex of fruit axis is used strengthen rope
2	Alu kher	*Imperata cylindrical*	*Poaceae*	**Wild**	Leaves used as jaru for clean room.
3	Bhol	*Luffa cylindrica*	*Cucurbitaceae*	**Wild**	Fruits used as bath brush
4	Jati Bahn	*Bambosa tulde*	*Poaceae*	**Wild**	Used as sleeping and drying.
5	Nirikal	*Cocus nucifera*	*Areceae*	**Wild**	Leaves used to clean room of court yard.

Conservation :- Early inhabitants of forests the forest as a valuable resource and used for their livehood to their best understand and without detriment to that resource also protected the forest through severed beliefs . Inspire of the protection extended through religious beliefs and practices, the forest in many parts of the area inhabited by the tea-garden community of Kamrup district suffer considerable interference and dame due to obvious reasons.

Conclusion :- This research will be of help the tea-garden communities as well as others to know about the ethno botany of these less known people. An intensive study was therefore, felt necessary to know about the immerse wealth of the different plant species available as well as plant species used by the tea-garden community in the Kamrup district. They use not only the edible ones but also, numerous medicinal and otherwise economic herbs for curing different diseases, common to the locality.

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Effect Of External Electric Field On O-H----O, O-H----N And N-H----N Hydrogen Bonded Dimmers: A Theoretical Study

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Abstract:

Effect of external electric field on the interaction energy as well as stability of the hydrogen bonded dimer of water, ammonia and water-ammonia are analyzed in light of density functional theory (DFT) and density functional reactivity theory (DFRT). Interaction energy as well as stability of the dimers (measured in terms of global hardness, total electronic energy and HOMO energy) is observed to be sensitive towards the strength and direction of the applied electric field. Reactivity parameters like global hardness and electrophilicity are also influenced significantly by the applied electric field.

Key words: DFT, DFRT, external electric field, hydrogen bonding.

Introduction:

Hydrogen bond is one of the most prolific non-covalent bonds that finds its overwhelming presence across different strata of science *viz.* physics, chemistry and biology. Diverse application of hydrogen bonding in interpretation of various structure, function and reactivity issues has been of great interest in both chemical and biochemical sciences.[1-2] Intramolecular and intermolecular hydrogen bonds are believed to be responsible for the binding between nucleobases, formation of DNA double helices, structural arrangement of carbohydrates, as well as for the folding patterns of proteins. Hydrogen bonds also play a key role in determining the shapes, properties and functions of various biomolecules. For instance, hydrogen bonding is instrumental in course of salt bridge formation by amino acids.[3]

Extent and strength of hydrogen bonding is affected by number of factors

such as presence of electron donating or withdrawing group, polarity of solvents, steric hindrance etc. Further, the strength of hydrogen bonds might affected by the presence of external electric fields. Especially in the context of biological systems, the ions present in cellular environment impart strong local electric field and it affects the hydrogen bonding in biomolecules. Recent works shows that biological systems can experience a strong field of magnitude ranging from ~10^8 to ~10^{10} Vm^{-1}.[4-5] Eventually, in a cellular environment reactivity pattern of biomolecules may be altered by the presence of such electric field. Effect of external electric field on the stability of drug-guanine adducts is documented in earlier literature.[6]

The effect of electric field on the chemical reactivity has been illustrated in several of earlier studies.[7-11] Particularly, the chemical reactivity as a function of orientation in the electric field has been investigated in depth.[7] Structural characterization of a water-micelle system in presence of an external electric field has been extensively studied by the use of MD simulations.[8] Chattaraj and his co-workers have observed the effect of electric field on the global and local reactivity indices and confirmed that electric field considerably affects all the local reactivity indices.[9] Pal and co-workers have studied the behavior of these descriptors in presence of external electric field as well as solvent media.[10] That introduction of electric field influences both physical and chemical properties of various molecular systems are evident from these studies. Recently a number of works has been devoted to the study of application of external electric field on biological molecules.[11]

In recent years density functional theory (DFT) has proved its applicability to interprete chemical reactivity in complex phenomenon.[12] Density functional reactivity theory (DFRT) finds utility in estimating reactivity parameters. These parameters, called reactivity descriptors, defined within the framework of density functional theory are global hardness (also called chemical hardness), electrophilicity, chemical potential etc.[13] These descriptors have been tested and studied by several research groups and are reportedly very useful in rationalizing the reactivity patterns in the molecular systems[14]. Geerlings *et al.* and Chattaraj *et al.* have reviewed the theoretical basis for these descriptors and their applicability[15]. Some of the recent developments and applications of these descriptors are highly appreciable[16].

Herein we have attempted to exploit the DFT and DFRT to study the effect of external electric fields on interaction energy and stability of the H_2O-H_2O, H_2O-NH_3 and NH_3-NH_3 dimers that contains O-H××××O, O-H××××N and N-H××××N hydrogen bonds.

Theoretical and Computational details:

In DFT, chemical potential (μ) and global hardness (η) are defined as the first and second derivative of energy with respect to the number of electrons respectively[17,18]. Use of finite difference approximation and Koopmans' theorem[19] leads to the working formulae for μ and η as:

$$\eta = \frac{\varepsilon_{LUMO} - \varepsilon_{HOMO}}{2} \quad (1)$$

and

$$\mu = \frac{\varepsilon_{LUMO} + \varepsilon_{HOMO}}{2} \quad (2)$$

Electrophilicity (ω) [20] is expressed as:

$$\omega = \frac{\mu^2}{2\eta} \quad (3)$$

The geometrical minima of the species are obtained using 6-311++G(d,p) basis set with Becke three parameter exchange and Lee, Yang and Parr correlation functional (B3LYP)[21] and is confirmed by frequency calculations. After locating the minima, single point energy calculations are carried out at different external electric field values in six directions (along positive and negative directions of x, y and z-axes, the sign + means that the field is applied along + direction of the axis and – sign means that the field is applied along the – direction of the axis). The range of the strength of the external field chosen from 0.00 a.u. to 0.01 a.u. [1 a.u. = 51.4 V/Å= $51.4 \times 10^{10} Vm^{-1}$]. The global reactivity descriptors (chemical potential, global hardness and electrophilicity) are calculated using equations (1)-(3).

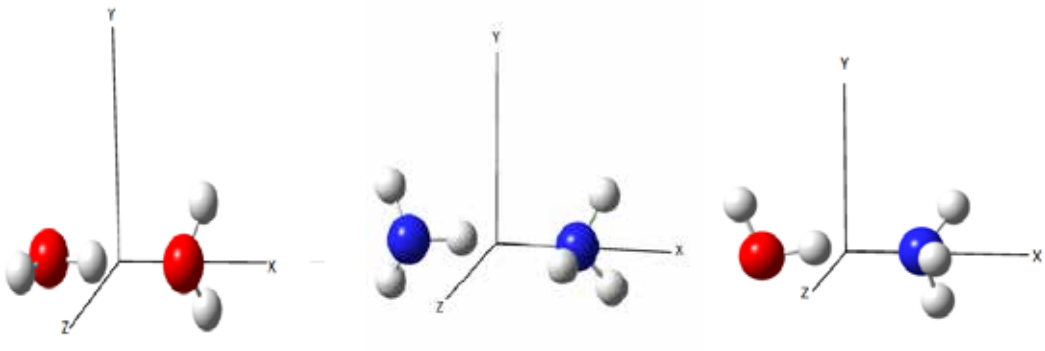
Strength of hydrogen bond is expressed in terms of interaction energy (ΔE_{int}) which is calculated using super molecular approach [for A + B → AB, $\Delta E_{int} = (E_{AB}) - (E_A + E_B)$, where, E is the total energy of the corresponding species]. Calculations are carried out using Gaussian09[22].

Results and discussion:

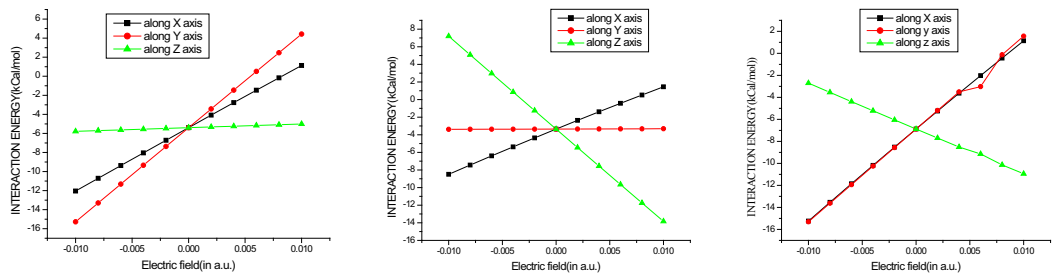
Effect of external electric field on the geometrical parameters is extensively studied in earlier literature.[23] Herein, the focus is to examine the variation of interaction energy and stability of the dimers on application of external electric fields.

Effect electric field on interaction energies:

Interaction energy is an important factor that governs the stability of a system. In view of this, the effect of the electric field on the interaction energies in the dimmers is scrutinised. Figs. 1a-1c shows the optimised geometry of the dimer along with their Cartesian axis and Figs. 1d-1f, depict the variation respective interaction energy along the three axes.



(a) Water dimer (b) Ammonia dimer (c) Water-ammonia dimer



(d) Water dimer (e) Ammonia dimer (f) Water-ammonia dimer

Fig. 1: (a)-(c) Optimized structures (obtained at B3LYP/6-31+G(d,p) level of theory) of the dimers showing the direction of the axes, (d)-(f) variation of interaction energy (in kcal/mol).

The gas phase interaction energies in the dimers are observed to be -3.35 kcal/mol, -5.40 kcal/mol, -6.87 kcal/mol for ammonia, water and ammonia-water respectively (in absence of an electric field). On applying an electric field upon the dimers, interaction energy is significantly changed and the effect produced by the field depends on the direction of the applied field. In case of water dimer, application of the field along *y*-axis leads to a sharp variation in interaction energies and the variation is observed to be insensitive towards applied field along *z*-axis and comparatively lesser variation along the *x*-axis, fig. 1d. Application of the field along $-y$ direction of water dimer leads to maximum interaction energy; -15.27 kcal/mol with 0.01 a.u. field; opposite results is observed along $+y$ direction.

Variation of interaction energy in case of ammonia dimer differs from that of water dimer. Maximum variation is observed along $-z$ direction; interaction energy is -13.83 kcal/mol in presence

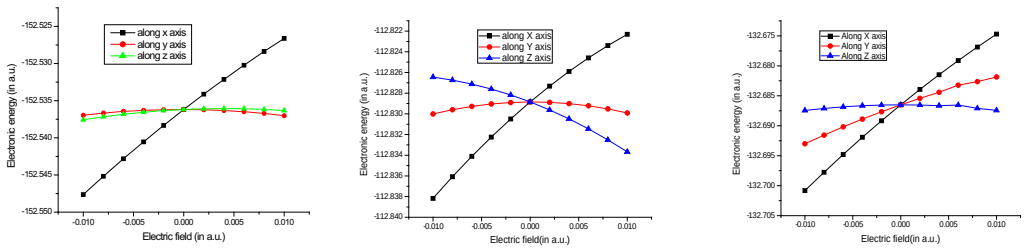
of field of strength of 0.01 a.u., fig. 1e. Significantly, interaction energy in ammonia dimer exhibits a moderate variation, in contrast to an intense variation in water dimer, towards application of the field along *y* and *x*-axis.

Interestingly, in case of water-ammonia dimer, application of the field along –*x* and –*y* directions leads to increase in interaction energy (-15.23 kcal/mol and -15.30 kcal/mol respectively upon application of field of strength 0.01 a.u.) and application of the field along *z*-axis show a reverse trend, Fig. 1f. This study advocates that the interaction energy of the dimers respond to the direction as well as strength of the applied electric field.

Variation of total electronic energy (E_{el}) of the dimers:

Total electronic energy of a system is also a measure of the stability of a system. Therefore, the variation of total electronic energies of the chosen dimers on application of electric field is examined; results are presented in fig. 2.

It is interesting to note that in gas phase, application of external electric field on the dimers perturb the total electronic energy of the system. In case of all the three dimers, application of the field along *x*-axis leads to a sharp variation in $E_{el,}$ Fig. 2. In contrast, application of fields along *y* and *z*-axis imparts almost no effect on E_{el} of water dimer, Fig. 2a. However, in case of water-ammonia and ammonia-ammonia dimers application of fields along *y* and *z*-axis (respectively) imparts significant effect on E_{el}, Fig. 2b-2c. E_{el} is observed to be indifferent to application of fields along *y* in case of ammonia dimer and *z*-axis in case of water-ammonia dimers. Moreover, it is worth mentioning that E_{el} of the dimers are sensitive toward the direction of the applied field; lowering of E_{el} results on application of the field along –*x* direction of all the dimers, *z* of ammonia dimer and –*y* direction of water-ammonia dimer. For e.g. on applying a field of strength 0.01 a.u. along –*x* direction causes a spiky fall in E_{el} by 7.15 kcal/mol, 5.83 kcal/mol , 8.97



a. Water dimer b. Ammonia dimer c. Water-ammonia dimer

Fig. 2: Variation of total electronic energy of the dimers at B3LYP/6-31+G(d,p) level of theory.

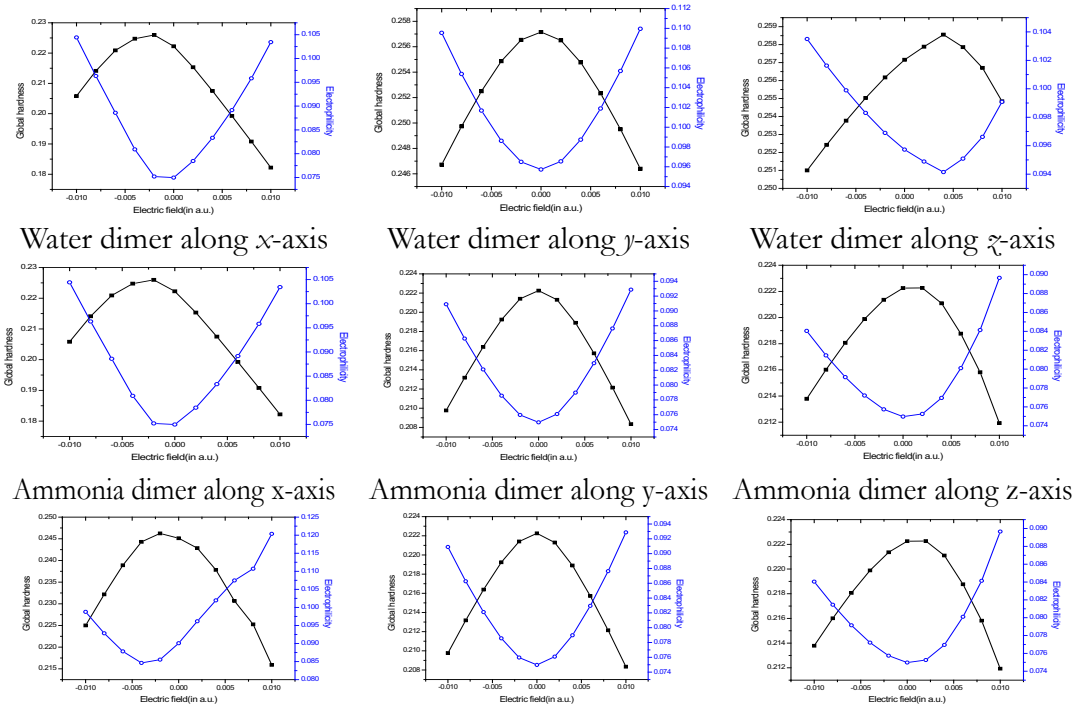
kcal/mol on water dimer, ammonia dimer and water-ammonia dimer respectively.

Variation of reactivity parameters of the dimers:

Variation of gas phase reactivity parameters, namely global hardness and electrophilicity of a system is indicative of their chemical stability in a changing environment and hence is important from chemical viewpoint. Variations of the gas phase global hardness and electrophilicity of the dimers along the three axes upon application of external electric field are presented in fig. 3.

From Fig. 3 it is evident that the gas phase global hardness of all the dimers decreases in a regular fashion on both sides of the axes imparting instability (and hence reactivity) to the systems. The implication lying herein advocates for a relatively lower chemical stability of all the three chosen dimers at higher field strength. Electrophilicity shows exactly the reverse trends; implying that both the MHP and MEP are obeyed.

Variation of HOMO of the adducts:



Water dimer along *x*-axis | Water dimer along *y*-axis | Water dimer along *z*-axis

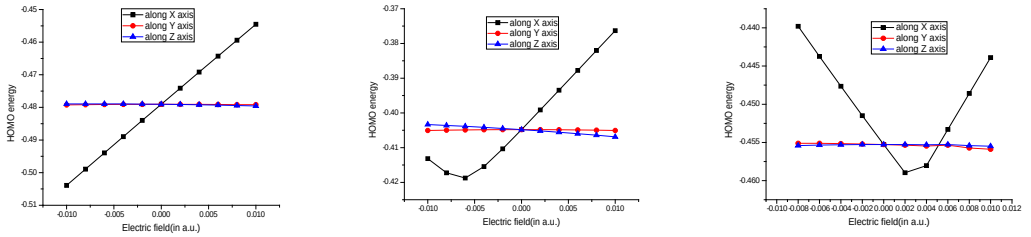
Ammonia dimer along x-axis | Ammonia dimer along y-axis | Ammonia dimer along z-axis

Water-ammonia dimer along *x*-axis | Water-ammonia dimer along *y*-axis | Water-ammonia dimer along *z*-axis

Fig. 3: Variation of gas phase global hardness and electrophilicity of the dimers (■ represents global hardness and ○ represents electrophilicity, at B3LYP/6-31+G(d,p) level of theory).

Variation of the HOMO energy of the dimers in presence external electric fields is traced. Plots of HOMO energy of the dimers with strength of the electric fields are shown in Fig. 4.

It is seen that application of the



Water dimer Ammonia dimer Water-ammonia dimer

Fig. 4: Variation of HOMO energy of the dimers with the applied field strength (at B3LYP/6-31G(d,p) level of theory).

electric field along *y* and *z*-axis does not lead to any change of the HOMO energy of the dimers. However, a considerable impact on HOMO energy is observed upon application of electric fields along *x*-axis. In case of water dimer, a sharp variation of HOMO energy is observed and HOMO energy drops by a magnitude of 15.6 kcal/mol on application of the field along $-x$ direction and a reverse trend is observed along $+x$ direction. In case of ammonia dimer, application of field of strength 0.06 a.u. along $-x$ direction drops the HOMO by 12.3 kcal/mol. In contrast, ammonia-water dimer shows an exceptional behaviour, HOMO energy increases on application of the field on either side of *x*-axis. Thus from the frontier orbital (HOMO) perspective, application of the field along *y* and *z*-axes does not impart any significant effect on the chemical stability of the system albeit, one can expect the dimers to be chemically stable under the influence of electric field applied along a particular direction.

Conclusion:

Hydrogen bonding has been of great interest in both chemical and biochemical sciences. The present study deals with the effect of the external electric field on hydrogen bonding in three dimers. Our findings suggest that the hydrogen bonding is significantly influenced by the presence of an external electric field and variation in interaction energy of the hydrogen-bonded systems inflicted upon by variation in the magnitude and direction of applied field vindicates this statement. Similarly, external electric field on the dimers perturbs the total electronic energy of the system. Reactivity of the dimer measured in terms reactivity parameter such as global hardness, electrophilicity and HOMO energy, shows that reactivity of the molecule can also

be modified in presence of the external electric field. Further, reactivity pattern of the dimers follow the MHP and MEP. Thus, this study will help future researchers to understand the behaviour of hydrogen bonded dimers in presence of the external applied field.

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Strongly Prime Modules In Near-Ring Modules

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Abstract: We deal with primeness in Near-ring modules. In this paper, we introduce the concept of strongly prime module as nonzero module M of a ring R to be strongly prime if $\forall 0 \neq m \in M$, there exists as subset F of R (depending on m) s.t. if $a \in R$ and $aFm=0$, then $a=0$ and study several features of this strongly prime ring modules.

1. Introduction: The study of strongly prime modules is done by Handelman and Lawrence Beachy introduced another notion of a strongly prime ring module. Groenewald extended the Handelman- Lawrence definition to near–ring and defined a near-ring R to be right strongly Prime and analogously, a near-ring is defined to be left strongly prime. Furthermore, in ideal P of R is called left strongly prime if R/P is a left strongly prime near-ring. In this section, we generalize these ideas to any R-module M.

2. Preliminaries: In this section, we recall some preliminary definitions and results to be used in the sequel.

2.1 Definition: A nonzero module M of a ring R is said to be strongly prime if for all $0 \neq m \in M$, there exists a finite subset F of R (depending on m) s.t. if $a \in R$ and $aFm=0$, then $a=0$

2.2 Definition: A nonzero module M of a ring R is said to be strongly prime (or Beachy-strongly prime) if for each $m' \in M$ and $0 \neq m \in M$, there exists a finite subset F of R s.t. $a \in R$ and $aFm=0$ implies $am'=0$

2.3 Definition: A near-ring R is said to be right strongly prime if for every $0 \neq a \in R$, there exists a finite subset F of R s.t. if $r \in R$ and $aFr=0$, then $r=0$

2.4 Definition: A near-ring R is said to be left strongly prime if for every $0 \neq a \in R$, there exists a finite subset F of R

s.t. r∈R and aFr=0, then r=0.

2.5 Definition: Let M be an R module s.t. RM≠0, then,

(a) M is said to be (left) strongly prime if for all 0≠m∈M, there exists a finite subset F= { r_1, r_2, ……., r_n}⊆R (depending on m) s.t. a∈R and aFm=0 implies aM=0

(b) An R-ideal P of M is said to be (left) strongly prime if RM≠P and M/P is a (left) strongly prime module. (i. e. for all m∈M\P, there exists a finite subset F of R s.t. a∈R and aFm=P implies aM=P).

Hereafter we shall refer to left strongly prime simply as strongly prime. Furthermore, if we refer to a module M as being strongly prime we would mean that it is strongly prime in terms of our definition above. It is quite clear (Proof can be seen in the proposition that follows) that a module M of near-ring R is HL-strongly prime⇒M is Beach-strongly Prime⇒M is strongly prime.

2.6 Definition: An R-module M is said to be cofaithful if there exists a finite subset F of M s.t. a∈R and aF=0 implies a=0

3.1 Proposition: Let M be an R-moduleof the near-ring R, then the following are equivalent :

(a) M is HL-strongly prime

(b) M is cofaithful and Beachy-strongly prime

(c) M is faithful and strongly prime

Proof:

(a) ⇒ (b) : If M is HL-strongly prime, then for each 0≠m€M, there exists a finite F⊆M such that a€R and aFm=0 implies a=0. So for each m'€M it also follows that am'=0 and therefore M is Beachy-strongly prime. To show that M is cofaithful, choose F'=Fm⊆M and the result follows.

(b) ⇒ (c) : Suppose M is cofaithful and Beachy-strongly prime. Since M is cofaithful, it is clearly also faithful and there exists F'={m_1, m_2,..., m_t}⊆M such that r∈R and rF'=0⇒r=0, Let 0≠m€M then, since M is Beachy-strongly prime, for each m1∈F'(1≤i≤t) there exists a finite F_i⊆R such that a⊆R and aF_im=0⇒am_i=0. Now let F=∪F_i Where i= 1, 2, …..t. then aFm=0⇒=∪F_i=0⇒am_i=0 for all i=1, 2, ….,t.

Thus aFm=0⇒aF'=0⇒a=0. Hence aM=0 and M is strongly prime.

(c) ⇒ (a) : Since M is strongly prime, for each0≠m€M, there exists a finite F⊆R such that a∈R and aFm=0 implies aM=0. Since M is faithful, a=0 and so M is HL-strongly prime.

3.2 Proposition: If M is a strongly prime R-module, then M is 3-prime.

Proof: Let a∈R and m∈M such that aRm=0. Suppose m≠0. Since M is strongly prime, there exists a finite subset F or R such that aFm⊆aRm=0 implies that aM=0. Hence M is 3-prime.

3.3 Proposition: Let M be a strongly prime R-module, then for every nonzero R-submodule S of M, there exists a finite subset F={s_1,s_2,., s_n}⊆S such that a∈R and aF=0 implies aM=0

Proof : Let 0≠S≤$_R$M and 0≠m∈S.

Since M is left strongly prime, there exists a finite subset $F=\{r_1,r_2,., r_n\}\subseteq R$ such that $a\in R$ and $aFm=0$ implies that $aM=0$, Let $F_1=F_m==\{r_1m,., r_2m, r_nm\}$. Then $F_1\subseteq S$ since S is an R-submodule of M. Furthermore $aF_1=0\Rightarrow aFm=0$ and hence it follows that $aM=0$.

3.4 Corollary: If R is near-ring with identity then the R-module M is strongly prime if and only if for every if for every nonzero R-submodule S of M, there exists a finite subset $F=\{s_1,s_2,..., s_n\}\subseteq S$ such that $aF=0$ implies $aM=0$

Proof: Let $0\neq m\in M$, Since R has identity $1.m=m\neq 0$. So the proof follows from the previous two propositions.

3.5 Proposition: Let M be a HL-strongly prime R-module. Then for every nonzero R-submodule S of M, there exists a finite subset $F=\{s_1,s_2,..., s_n\}\subseteq S$ such that $a\in R$ and $aF=0$ implies $a=0$.

Proof: follows by a similar argument used in the proof of proposition 3.3

3.6 Proposition: Let M be an R-module such that for every $0\neq m\in M$ there exists an $r\in R$ such that $rm\neq 0$. If for every nonzero R-submodule S of M, there exists a finite subset $F=\{s_1,s_2,..., s_n\}\subseteq S$ such that $a\in R$ and $aF=0$ implies $a=0$, then M is HL-strongly prime.

Proof: Follows by a similar argument used in the proof of above proposition.

3.7 Corollary: If R is a near-ring with identity then the R-module M is HL-strongly prime if for every nonzero R-submodule S of M, there exists a finite subset $F=\{s_1,s_2,..., s_n\}\subseteq S$ such that $aF=0$ implies $a=0$

3.8 Proposition: If R a near-ring with identity and M is an R-module with no nonzero, proper R-submodule then M is Beachy-strongly prime.

Proof: Let $m\in M$ and $0\neq m_1\in M$. Since R has an identity element, we have that $Rm_1=M$. So there exists an $r\in R$ such that $m=rm_1$.If we let $F=\{r\}$ and $aFm_1=0$, then $am=arm_1=0$. Thus M is Beachy-strongly prime.

4. Conclusion: The result in this paper give only the concept of strongly prime module of a ring. Many more information regarding its properties and applications can be expected.

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Fuzzy Bi-Topological Space And Separation Axioms

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Abstract : We deal with Fuzzy bi-topological Space and Separation Axioms. In this paper, we introduced the concept of Fuzzy Bi-topological Space which is a non empty Set X equipped with two fuzzy topologies on it and different pair wise separation Axioms are defend as generalization of natural Separation axioms.

Introduction :

A fuzzy bi-topological space is a non-empty Set X equipped with two fuzzy topologies on it. Different pairwise separation axioms are defined as generalization of natural separation axioms in the sense that such a notion reduces to the natural separation axioms of a fuzzy topological space when two topological spaces coincide. In this paper, pairwise, separation axioms are introduced and a mixed topology is introduced with the help of two fuzzy topologies of a fuzzy bi-topological space. Relation between such pairwise separation axioms and natural fuzzy separation axioms of the mixed fuzzy topological space are investigated. Finally, pairwise fuzzy normal bi-topological space, pairwise weakly and pairwise strongly separated space are introduced and investigated their properties with the mixed topology.

3. Preliminaries :- For an easy understanding of the material incorporated in this paper, we reproduce the following definitions and results which can be found in any standard textbook on fuzzy topological space.

4. Fuzzy Bi-topological Space : To cope up with the material incorporated in this paper, we need some rudiments of fuzzy topological space. We follow the terminology and the results of the paper [12], [53], [93] and [97]. Now we define separation axioms in a fuzzy bi-topological space.

Definition 4.1 : A fuzzy bi-topological space space $(X, \mathfrak{I}_1, \mathfrak{I}_2)$ is said to be pairwise T_1 if of every pair of distinct fuzzy points x and y in X, there exits $\mathfrak{I}_1$ open set U and a $\mathfrak{I}_2$ open set V. s.t. U (x) = 1, $y \notin V$ and $x \notin V$, V (y) = 1.

Definition 4.2 : A fuzzy bi-topological space $(X, \mathfrak{I}_1, \mathfrak{I}_2)$ is said to be pairwise fuzzy Hausdorff space if for each pair of distinct points x and y, there are $\mathfrak{I}_1$ open set U and a $\mathfrak{I}_2$ open set V s.t. U (x) = 1, V (y) = 1 and $U \cap V = 0$.

Definition 4.3 : A fuzzy bi-topological space $(X, \mathfrak{I}_1, \mathfrak{I}_2)$ is called – pairwise fuzzy regular w.r.t. $\mathfrak{I}_2$ iff $\alpha \in (0, 1)$, $U \in \mathfrak{I}_1^c$, $x \in X$ and $\alpha < 1\text{-}U(x)$ imply that there exits $V \in \mathfrak{I}_2$ and $W \in \mathfrak{I}_2$ with $\alpha < V(x)$ $V \subseteq V$ and $V \subseteq 1\text{-}W$. $(X, \mathfrak{I}_1, \mathfrak{I}_2)$ is called pairwise fuzy regular if it is – fuzzy regular with respect to $\mathfrak{I}_1$ and $\mathfrak{I}_2$ fuzzy regular with respect to $\mathfrak{I}_1$.

The following theorem plays a key role in the sequel. It is a relation between compactness and closeness of a subject of a pairwise Hausdorff bi-topological space. The ordinary subset Y is regarded as a fuzzy subset.

Definition 4.4: If $(X, \mathfrak{I}_1, \mathfrak{I}_2)$ is a pairwise Hausdorff fuzzy bi-topological space and Y is an ordinary -- 1 compact fuzzy set in X then Y is -- closed.

Proof : It is sufficient to show x_λ is not in Y implies x_λ is not an accumulation point of Y. $x_\lambda \notin Y$ means $1 > \lambda > y(x)$ and therefore, $x \notin Y$. So, $x \neq Y$ for all $y \in Y$. by the pairwise Hausdorff character of $(X, \mathfrak{I}_1, \mathfrak{I}_2)$ there exists a $\mathfrak{I}_1$ open set U and a $\mathfrak{I}_2$ open set V s.t. U (x) = V (y) and $U \cap V = 0$. Thus, for $x_\lambda \notin Y$ and $y \in Y$. U (x) = (V∩Y) = 1 with $U \cap V = 0$. Varying y over all points belonging to Y, the collection {Y∩V} is an 1^*-shading of Y. so, it is reducible to a finite 1^*-subshading say, $\{Y \cap V_{y1}, Y \cap V_{y2}, \ldots\ldots\ldots Y \cap V_{yn}\}$. We write $V = V_{y1}$

Since, $U^{y1}{}_x$ (x) = 1 for all $1 \leq i \leq n$, we have U (x) = 1 and $x_\lambda \in U$. Now $U \cap V = (U^{y1}{}_x \cap \ldots\ldots, \cap U^{yn}{}_x) \cap (V_{y1} \cup V_{y2} \cup \ldots\ldots \cup V_{yn}) = 0$ for $y \in Y$, there exists $Y \cap V_{y1}$ s. t. $Y \cap V_{y1}$ (y) =1 implies $Y \cap V$ (y) =1=Y (y) therefore $Y \cap V = Y$. Also, $Y \cap U = Y \cap V \cap U = 0$ implies that Y (x) =0 or U (x) =0. Therefore, Y (x) + U (x) >1. Hence Y and U are not quasi-coincident, and therefore x_λ is not a $\mathfrak{I}_1$ – accumulation point of Y. This proves that Y is $\mathfrak{I}_1$ closed.

4.5 Definition : In a pairwise fuzzy Hausdorff space $(X, \mathfrak{I}_1, \mathfrak{I}_2)$ is $\mathfrak{I}_1 - 1^*$ compact subset is $\mathfrak{I}_2$ –closed.

4.6 Definition : With the help of two fuzzy topologies of a fuzzy bi-topological space a thirdb fuzzy topology is defined on it. This topology is named as mixed fuzzy topology. We then relate separation axioms relative to the mixed topology with pairwise separation axioms of the fuzzy bi-topological space.

4.7 Definition : Let $(X \mathfrak{I}_1, \mathfrak{I}_2)$ be a fuzzy bi-topological space, $\{Y_\alpha\}$ be a collection of ordinary subsets of X which are $\mathfrak{I}_2$ 1^* - compact as fuzzy subsets.

Let, $\tau = \{i_\alpha, : Y \rightarrow X\}$ and $(\mathfrak{I}_\beta)$ be the collection of fuzzy topologies on X s. t.

$I_\alpha : (Y_\alpha, \mathfrak{I}_1) \rightarrow (X, \mathfrak{I}_\beta)$ are continuous where $(Y_\alpha, \mathfrak{I}_1)$ means subspace topology on X s.t. ia are continuous. That is, $\mathfrak{I}_1$ $(\mathfrak{I}_2)$ is topology s.t.

(a) $\mathfrak{I}_1$ $(\mathfrak{I}_2) \supseteq \mathfrak{I}_\beta$, for all β s. t. $i_\alpha : (Y_\alpha, \mathfrak{I}_1) \rightarrow (X, \mathfrak{I}_1)$ $(\mathfrak{I}_2))$ are continuous.

(b) If $(\mathfrak{I}_0) \supseteq \mathfrak{I}_\beta$, for all β and $i_\alpha : (Y_\alpha, \mathfrak{I}_1) \rightarrow (X, \mathfrak{I}_0)$ are continuous then $\mathfrak{I}_0 \supseteq \mathfrak{I}_1$ $(\mathfrak{I}_2)$

The fuzzy topology $\mathfrak{I}_1$ $(\mathfrak{I}_2)$ is called a mixed fuzzy topology on X. Clearly, $\mathfrak{I}_1 \in \{\mathfrak{I}_\beta\}$ and therefore, $\mathfrak{I}_1 \subseteq \mathfrak{I}_1$ $(\mathfrak{I}_2)$. Although we have used the symbol $\mathfrak{I}_1$ $(\mathfrak{I}_2)$ for the mixed topology arising out of fuzzy topologies $\mathfrak{I}_1$ and $\mathfrak{I}_2$. This mixed topology $\mathfrak{I}_1$ $(\mathfrak{I}_2)$, is not the same as $\mathfrak{I}_1(\mathfrak{I}_2)$, of the preceding paper Cf 3.2.1). The theorem 4.2 is applied to the rest of this paper. The following theorem shows that relation between Hausdorff character of the mixed topology and the pairwise Hausdorff character of the bi-topological space.

4.8 Definition : If $(X \mathfrak{I}_1, \mathfrak{I}_2)$ is a pairwise fuzzy Hausdorff space then the mixed fuzzy topology $\mathfrak{I}_1$ $(\mathfrak{I}_2)$ is a fuzzy Hausdorff topology.

Proof :- Since $(X \mathfrak{I}_1, \mathfrak{I}_2)$ is a pairwise fuzzy Hausdorff space, x, y ∈ X and x ≠y there exist $U \in \mathfrak{I}_1$ and $V \in \mathfrak{I}_2$ U (x) = V (y) s.t. $U \cap V = 0$. To prove that $(X, \mathfrak{I}_1, (\mathfrak{I}_2))$ is a fuzzy Hausdorff space, we claim that both U and V are $\mathfrak{I}_1$, $(\mathfrak{I}_2)$ open. Let, Y_α be ordinary subsets of X which are 1*-compact w.r.t. fuzzy topology $\mathfrak{I}_2$ Let, □ $=\{i_\alpha : Y \rightarrow X\}$ and $(\mathfrak{I}_\beta)$ be the collection of inclusion mappings and fuzzy topologies on X s.t. $i_\alpha : (X, \mathfrak{I}_1, (\mathfrak{I}_2)) \rightarrow (X, \mathfrak{I}_\beta)$ are continuous. For each $z \in Y_\alpha$, i_α^{-1} (U) (z) = U $((i_\alpha (z) = \min \{Y_\alpha (z), U(z)\} = (Y_\alpha \cap U) (z)$

Therefore, i_α^{-1} (U) is $(Y_{\alpha,} \mathfrak{I}_1)$ open Since $\mathfrak{I}_1$ is coarser than $\mathfrak{I}_1$ $(\mathfrak{I}_2)$ $\mathfrak{I}_1$-open set U is $\mathfrak{I}_1$ $(\mathfrak{I}_2)$-open. Similarly, $K = i_\alpha^{-1}$ $(v) = Y_\alpha \cap V$ is open in $(Y_{\alpha,} \mathfrak{I}_2)$ and therefore its complement in Y_α, Y_α -K is closes $(Y_{\alpha,} \mathfrak{I}_2)$. Application of proposition 1.7.9 shows that Y_α –K is $(Y_{\alpha,} \mathfrak{I}_2)$ – 1*-compact. Also $(Y_{\alpha,} \mathfrak{I}_1 \mathfrak{I}_{2,})$ inherits pairwise Hausdorff character from $(X, \mathfrak{I}_1, \mathfrak{I}_2)$. Then by theorem 4.2.4, Y_α –K is $(Y_{\alpha,} \mathfrak{I}_1)$ closed and i_α^{-1} (v) = $Y_\alpha \cap v$= K is $(Y_{\alpha,} \mathfrak{I}_1)$ open for every Y_α. We claim that $v \in \mathfrak{I}_1$, $(\mathfrak{I}_2)$. Let $\mathfrak{I}_0 = \{v \mid i_\alpha^{-1} (v) \in (Y_{\alpha,} \mathfrak{I}_1)$ open for every Y_α we claim that $v \in \mathfrak{I}_1$ $(\mathfrak{I}_2)$. Let $\mathfrak{I}_0 = \{v \mid i_\alpha^{-1} (v) \in (Y_{\alpha,} \mathfrak{I}_1)$ for all $Y_\alpha\}$Now $\mathfrak{I}_0$ is a topology on X s.t. i_α $((X, y_\alpha, \mathfrak{I}_1))$ $\rightarrow$ $((X, \mathfrak{I}_0)$ are continuous So, $\mathfrak{I}_0$ is one of the members of $\{\mathfrak{I}_\beta\}$ and hence $\mathfrak{I}_0$ is $\subseteq \mathfrak{I}_1$ $(\mathfrak{I}_2)$. Now , $K = Y_\alpha \cap V = i_\alpha^{-1}(v) \in (Y_{\alpha,} \mathfrak{I}_1)$ for all Y_α So, $V \in \mathfrak{I}_0 \subseteq \mathfrak{I}_1$ $(\mathfrak{I}_2)$ Now, $K = Y_\alpha \cap V = i_\alpha^{-1}(v) \in (Y_{\alpha,} \mathfrak{I}_1)$ for all Y_α So, $V \in \mathfrak{I}_0 \subseteq \mathfrak{I}_1$ $(\mathfrak{I}_2)$. This prove that $V \in \mathfrak{I}_1$ $(\mathfrak{I}_2)$. Thus x,y∈X and x≠ y implies that there exists $U \in \mathfrak{I}_1$ $(\mathfrak{I}_2)$ and $V \in \mathfrak{I}_1$ $(\mathfrak{I}_2)$ with U(x) =V(y)=1 and $u \cap v = 0$. Therefore , $(X, \mathfrak{I}_1, (\mathfrak{I}_2))$ is a fuzzy Hausdorff space.

4.9 Definition : Several authors have studied fuzzy regularity in different ways. Some of which are equivalent and others are independent as shown by Dewan M. Ali [35]. The following lemmas are asso-

ciated with the theorem of pairwise fuzzy regular bi-topological spaces.

4.10 Definition : If U is a closed relative to subspace topology on y induced from then $\mathfrak{I}$, $U=Y\cap U_0$ where V_0 is $\mathfrak{I}$-closed.

Proof :-Here the subspace topology $\mathfrak{I}_{1y}=\{Y\cap G \mid G\in\mathfrak{I}\}$. U is $\mathfrak{I}_{1y}$ –closed. So 1-U is $\mathfrak{I}_{1y}$ –open. 1-U=Y∩V where V is $\mathfrak{I}$-open. Therefore 1-U(y)=min {Y(y), V(y)}= min {1, V(y)}=V(y) implies that U(y)=1-V(y)=min {Y(y), 1-V(y)} = $(Y\cap V^c)$ (y). Therefore $U=(Y\cap V^c)=Y\cap U_0$. Since V is $\mathfrak{I}$-open, $V^c=U_0$ is $\mathfrak{I}$-closed. Here is the representation of open subsets of the supremum topology $V\mathfrak{I}_\alpha$ defined in 4.3.1.

4.11 Definition : V $\mathfrak{I}_\alpha$–open sets are Union of finite intersections of different $\mathfrak{I}_\alpha$–open sets

Proof :- Let $\mathfrak{I}$ be the collection of Unions of finite intersections of members $U\mathfrak{I}_\alpha$, that is $\mathfrak{I}=\{U(\bigcap_{i=1}^{n} U_i),\ U_i\in U\ \mathfrak{I}_\alpha$ Clearly $\mathfrak{I}$ is a fuzzy topology and (i) $\mathfrak{I}\supseteq\mathfrak{I}_\alpha$ for all α

(ii) If $\mathfrak{I}_0$ is fuzzy in $\mathfrak{I}_0\supseteq\mathfrak{I}_\alpha$ for all α, then, $\mathfrak{I}_0\supseteq\mathfrak{I}\supseteq\mathfrak{I}_\alpha$. Let $U(\bigcap_{i=1}^{n} U_i)\in\mathfrak{I}$, Where $U_i\in U\ \mathfrak{I}_\alpha$ then $U_\alpha(\bigcap_{i=1}^{n} U_i)\notin\mathfrak{I}$,

$\mathfrak{I}_0$ for some $i=i_0\Rightarrow U\notin\mathfrak{I}_\alpha$ for all α, which contradicts that $U\in U\mathfrak{I}_\alpha$. Hence $U_n(\bigcap_{i=1}^{n} U_i)\in\mathfrak{I}_0$ Therefore, $\mathfrak{I}\subseteq\mathfrak{I}_0$ and $\mathfrak{I}$=1.u.b. $\mathfrak{I}_0$.

4.12 Definition : f: $(X, \mathfrak{I}) \rightarrow (Y, \mathfrak{I}_\alpha)$ is continuous for all if f: $(X, \mathfrak{I}) \rightarrow (Y, V\ \mathfrak{I}_\alpha)$ is continuous.

Proof :- (i) Let f: $(X, \mathfrak{I}) \rightarrow (Y, \mathfrak{I}_\alpha)$ is continuous for all α $U\in V\mathfrak{I}_\alpha$, then $U=U(\bigcap_{i=1}^{n} U_i)$ Now $f^{-1}(U(\bigcap_{i=1}^{n} U_i)=U(\bigcap_{i=1}^{n} f^{-1}U_i)\in\mathfrak{I}$. Hence f is continuous from $(X, \mathfrak{I})$ to $(Y, \mathfrak{I}_\alpha)$

for all α.

(ii) Let f: $(X, \mathfrak{I}) \rightarrow (Y, V\mathfrak{I}_\alpha)$ be continuous Every U in $\mathfrak{I}_\alpha$ is in $V\mathfrak{I}_\alpha$ and hence

$f^{-1}(U)\in\mathfrak{I}$. Hence f: $(X, \mathfrak{I}) \rightarrow (Y, \mathfrak{I}_\alpha)$ is continuous.

4.13 Definition : Let $((X, \mathfrak{I}, \mathfrak{I})$ be pairwise fuzzy Hausdorff and pairwise fuzzy regular space, Y_k be $\mathfrak{I}_2$-1*-compact ordinary subsets of X when regarded as fuzzy subsets and $\mathfrak{I}_1(\mathfrak{I}_2)_{1yk}$ is fuzzy regular for each Y_k

Proof :- Suppose $x\in Y_k$ and $U\in\mathfrak{I}_1(\mathfrak{I}_2)_{1yk})^C$ and $\alpha\in$ (0,1), s.t. α<1-U

(x). Then by lemma 4.4.1, $U=Y_k \cap U_1$ where U_1 is $\mathfrak{I}_1(\mathfrak{I}_2)$ – closed. By the continuity of $i_{yk} : (Yk, \mathfrak{I}_1) \rightarrow (X \mathfrak{I}_1, \mathfrak{I}_2))$, $i^{-1}_{yk}(U_1)$ $\mathfrak{I}_{1\,1yk}$ closed, i.e. $U=Y_k \cap U_1$ is $\mathfrak{I}_{1\,1yk}$ –closed. Since Y_k is $\mathfrak{I}_1$-1*-compact set in the pairwise Hausdorff space $(X, \mathfrak{I}_1, \mathfrak{I}_2)$, by theorem 4.2.4, Y_k is $\mathfrak{I}_1$-closed. Therefore by lemma 4.4.1 U is $\mathfrak{I}_1$-closed. Since $(X, \mathfrak{I}_1, \mathfrak{I}_2)$ is pairwise fuzzy regular there exists $V \in \mathfrak{I}_1$ and $W \in \mathfrak{I}_2$ with $\alpha < V(x)$ $U \subseteq W$ and $V \subseteq 1\text{-}W$ Also $V \in \mathfrak{I}_1 \subseteq \mathfrak{I}_1$ $(\mathfrak{I}_2)$ implies $V \in \mathfrak{I}_1 \subseteq \mathfrak{I}_1$ $(\mathfrak{I}_2)$. It can be shown that $W \in \mathfrak{I}_1$ $(\mathfrak{I}_2)$ as argued in proposition 4.3.2. We have $U \subseteq Y_k \cap W$, $\alpha < Y_k \cap V)$ (x) and $Y_k \cap V \subseteq 1\text{-}Y_k \cap W$. Therefore, $(Y_k, \mathfrak{I}_1, \mathfrak{I}_2))$, i^{-1}_{yk} is fuzzy regular.

4.14 Definition : Let $(X, \mathfrak{I}_1, \mathfrak{I}_2)$ be a pairwise fuzzy Hausdorff space in which every $\mathfrak{I}_2$-1*-compact sets are $\mathfrak{I}_2$-1*-compact. Let Y_k $\mathfrak{I}_2$-1*-compact ordinary sets and $\mathfrak{I}_1(\mathfrak{I}_2)$ be the mixed topology on X. If $(X, \mathfrak{I}_1, \mathfrak{I}_2))$ is a fuzzy regular space then $Y_k, \mathfrak{I}_1 i^{-1}_{yk}, \mathfrak{I}_2 i^{-1}_{yk})$ is pairwise fuzzy regular for each Y_k.

Proof :- Suppose $x \in Y_k$ U is a $\mathfrak{I}_1$ i^{-1}_{yk} closed set and $U=Y_k \cap U_0$ where U_0 is $\mathfrak{I}_1$–closed and Y_k is $\mathfrak{I}_1$-closed [Cf 4.2.4]. Then U is $\mathfrak{I}_1$ $(\mathfrak{I}_2)$-closed. Since $(X, \mathfrak{I}_1, \mathfrak{I}_2))$ is fuzzy regular, for $\alpha \in (0,1)$, $U \in (\mathfrak{I}_1, \mathfrak{I}_2))^C$, $x \in X$ and $\alpha < 1\text{-}U$ (x) there exist V, $W \in \mathfrak{I}_1, \mathfrak{I}_2)$ with $\alpha < 1\text{-}V(x)$, $U \subseteq W$ and $V \subseteq 1\text{-}W$. Now $i^{-1}_{yk}(v) = Y_k \cap V$ is $\mathfrak{I}_{1\,1yk}$ – open and hence $[1\text{-}Y_k \cap V]$ is $\mathfrak{I}_{1\,1yk}$ closed. Since Y_k is $\mathfrak{I}_1$-1*-compact, $[1\text{-}(Y_k \cap V)]$ is $\mathfrak{I}_{2\,1yk}$ closed and hence $Y_k \cap V$ is $\mathfrak{I}_{2\,1yk}$ open and $U \subseteq Y_k \cap W$. Now $i^{-1}_{yk}(w) = Y_k \cap W$ is $\mathfrak{I}_{2\,1yk}$ open. Therefore $Y_k \cap V \in \mathfrak{I}_{2\,1yk}$ and $Y_k \cap W \in \mathfrak{I}_{2\,1yk}$, $Y_k \cap V \subseteq 1\text{-}(Y_k \cap W)$. So, $(Y_k, \mathfrak{I}_{1\,1yk}, \mathfrak{I}_{2\,1yk})$ $\mathfrak{I}_{2\,1yk}$ is regular w.r.t. . Hence $(Y_k, \mathfrak{I}_{1\,1yk}, \mathfrak{I}_{2\,1yk})$ is pairwise fuzzy regular for each Y_k. This completes the result.

5. Conclusion :- The results in this paper gives the structural properties of a Fuzzy bi-topological space and pairwise separation axioms as generalization of natural separation axioms. Many more informations regarding its structural properties and applications can be expected.

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Structural And Optical Properties Of Spherical Shaped Wurtzite ZnS Nanoparticles In PVA Matrix

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Abstract:

Nanocrystalline ZnS-PVA composite thin film is deposited on glass substrate by means of chemical method. The structural and morphological studies are carried out using XRD and TEM. The X-ray diffractogram of the sample shows wurtzite structure with preferred orientations along (002), (110) and (112) planes. The crystallite size is found be 3.54 nm. TEM micrograph of the film reveals the formation of spherical ZnS nano particles. The bandgap of the synthesized material is calculated using UV- Visible spectral analysis and bandgap plot. The bandgap value is found to be 3.8eV. Also we have used photoluminescence study to identify the defects in the nanostructure.

1. Introduction:

Nanomaterials are studied extensively because they show very different properties compared to what they exhibit in bulk form [1-3]. For example, as the size of the system decreases, the quantum size effect becomes pronounced where the electronic properties of the solid are altered. Meanwhile, the increase of surface to volume ratio changes the mechanical, thermal and catalytic properties of the material significantly. The distinct properties enable unique applications of nanomaterials. As an important II-VI group semiconductor material, ZnS has been intensively studied because of its wide application in optical sensor, photo catalysts in environmental protection, light emitting diodes, electroluminescence devices, photovoltaic devices, lasers, single electron transistors as well as biological sciences and diagnostics [4-13]. ZnS has wide bandgap of 3.68eV at room temperature. This bandgap can be

enhanced by decreasing the sizes of the crystallites.

In the present study, we report the successful synthesis of ZnS spherical nanoparticles in the polyvinyl alcohol (PVA) solution by chemical method. PVA is a hydrophilic polymer frequently used as a matrix for stabilization of ZnS nanocrystals extensively [14, 15].

2. Experimental details:

Nanocrystalline ZnS-PVA composite thin films are deposited on glass substrate by chemical route at 90^0C. The synthesis is carried out as follows- $1.33x10^{-5}$ mol PVA is stirred in 75 ml distilled water for 1.5hr with temperature controlled magnetic stirrer. Then the PVA solution is kept at rest for 2 hrs. A solution of 0.005mol zinc acetate in 5 ml NH_4 (OH) is mixed to the PVA solution. Lastly, a solution prepared by taking 0.015ml Na_2S in 25 ml distilled water is added to the above solution. Then the resulting mixture is heated to the temperature 90^0C and kept steadily at that temperature for 20 minutes. The solution containing ZnS-PVA is cast over glass slides to produce thin film form. After deposition of the films, the films are dried in vacuam and set for various characterizations. Structural characterizations of the films are determined by Philips X'pert prodiffractometer (PW-1830) at room temperature with CuK_α (1.54A°) radiation. Morphological studies are carried out using Transmission Electron Microscopy (JEM 100CXII JEOL, Japan). Optical transmission spectrum of the film is taken with the help of a UV Spectrometer (Hitachi U-3210 Spectrometer). Photoluminescence spectrum is recorded by Hitachi F-2500 Fluorescence Spectrometer.

3. Results and Discussions:

3.1 XRD Study:

Fig. 1 shows the X-ray diffractogram of the ZnS-PVA composite film. X-ray diffractogram of the film shown in fig. 1 exhibit broadened diffraction profile confirming formation of ZnS nanocrystals.

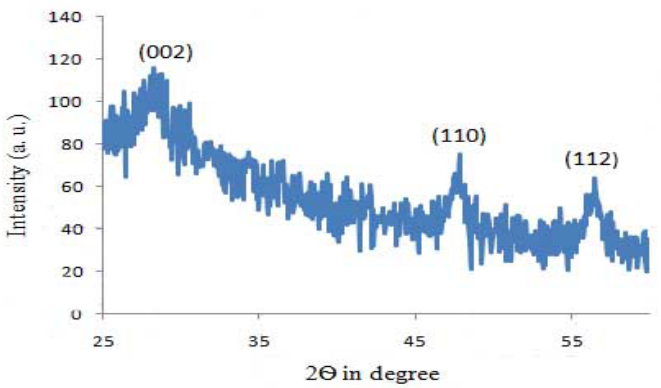

Fig.1 XRD spectrum of ZnS nanoparticles

The analysis of the profile shows preferred orientations along (002), (110) and (112) planes. The crystallite size (D) of the Nanocrystalline film is estimated by using Debye-Scherrer formula

$$D=0.89\lambda/\beta\cos\theta \quad (1)$$

Where λ, β and θ are the wavelength of the CuK_α radiation (1.54A°), full width at half maximum of the diffraction peak and diffraction angle respectively. The average crystallite size of the synthesized ZnS nanoparticles is found to be 3.54 nm.

3.2 TEM Study:

Fig. 2 shows the surface morphology of ZnS thin film deposited at 90^0 C. From the micrograph, it is observed that in the film the distribution of grains are not uniform throughout all the regions, but the film is without any void, pinhole or cracks and the grains cover the substrate surface well. We have clearly observed the nanosized spherical grains. The average grain size is found to be 6.10nm.

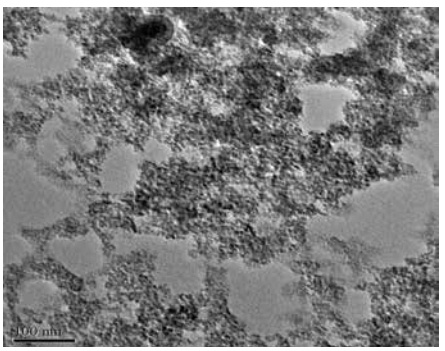

Fig.2 TEM micrograph of the synthesized ZnS nanoparticles

3.3 Optical Absorption Study:

Optical studies are carried out by measuring transmittance of the ZnS-PVA composite film deposited on glass substrate. Fig. 3(a) shows the transmittance (T) versus wavelength (λ) spectra of the as deposited film.

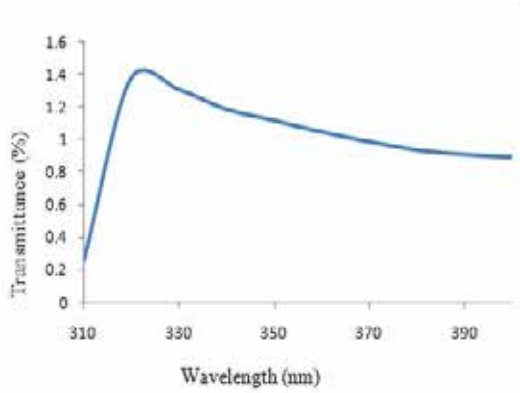

Fig. 3(a) UV-Visible transmission spectrum

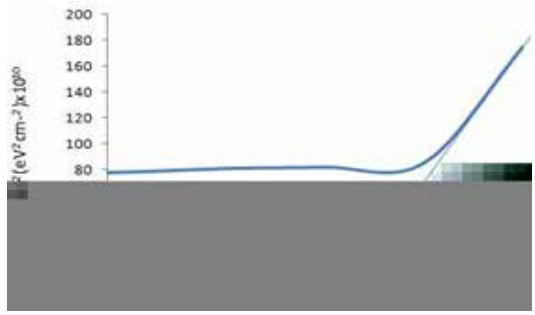

Fig. 3(b) Taue plot of ZnS nanoparticles

The relation between absorption coefficient (α) and incident photon energy (hυ) can be written as [16]

$$a = A\,(h\nu - E_g)^n / h\nu \quad (2)$$

where A is a constant, Eg is the band gap of the material and the exponent n depends on the type of transition. The

values of n for direct allowed, indirect allowed, direct forbidden transition are n = ½, 2 and 3/2 respectively. Graph between (hυ) versus $(\alpha h\upsilon)^2$ is plotted for the film is shown in fig. 3 (b) and the intercepts of the extrapolated straight line at $(\alpha h\upsilon)^2 = 0$ gives the direct band gap Eg of the material. The value of Eg is obtained as 3.80eV. It is observed that the bandgap value is higher than the bulk ZnS (3.6eV) which is due to the quantum confinement effect.

3.4 Photoluminescence:

PL spectrum measured at room temperature (290K) of the nanocrystalline ZnS-PVA composite film is shown in fig. 4. The sample is excited at 260nm. We have observed a weak peak centered 440nm and strong peak centered at 510nm. The weak peak, in more or less blue region of the spectrum is due to defect related emission of ZnS with short life time and the strong peak may be attributed to the stoichiometric defects, which might be a vacancy or an interstitial states.

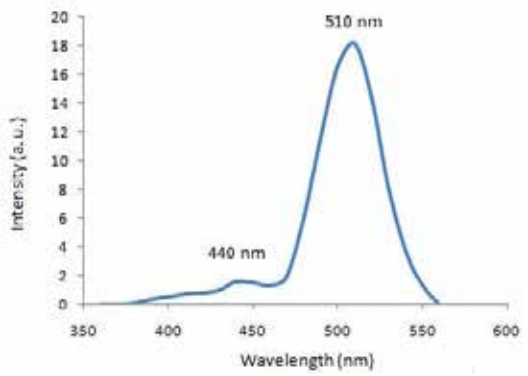

Fig. 4 Photoluminescence Spectrum of ZnS nanoparticles

4. Conclusion:

Spherical ZnS nanoparticles have been successfully synthesized by means of chemical method. The as-synthesized ZnS spherical nano particles have a wurtzite structure. The bandgap for direct optical transition of the synthesized ZnS nanoparticles is found to be 3.80 eV which is greater than its bulk value. These nanoparticles with green emission represent good candidates for use in optoelectronic devices.

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Study Of Tensile Property Of Muga And Eri Silk (Normal)

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ABSTRACT

Among all the silk varieties golden yellow Muga silk (*Antherea assama*) is the most elegant strong and durable which is indigenous to the North Eastern Region in general and Assam. The amount of water held within a fibre can have a considerable influence on its tensile properties. Silk has moisture region of 10% at 65%, relative humidity and 23.8% at 95% relative humidity. The tensile parameters of Eri and Muga fibres are study in this paper and found that the elongation, average tenacity g/den and initial modulus g/den of Muga and Eri are 34.51, 35.80, 4.96, 5.54 and 1.54 and2.47 respectively.

Key Words : Tenacity, Normal

INTRODUCTION :

TENSILE PROPERTIES OF FIBRES:

The mechanical properties of textile fibres, the response to applied force and deformations, are probably their most important properties technically, contributing both to the behaviour of fibres in processing and to the properties of the final product. Because of their shape, the most standard and in many applications the most important properties are their tensile properties – their behaviour under forces and deformations applied along the fibre axis.

Fibres consist essentially of long chain molecules in which comparatively simple groups of atoms are joined together by a condensation or addition polymerization reaction to form a long chain of atoms joined by primary valancy linkages. The degree to which the individual molecules can bend, stretch or coil is restricted by the mutual interaction of active groups along the molecule. In most cases the intermolecular forces are in the nature of secondary bonds as hydrogen bonds or van der Wall's forces.

Silk filaments consist of polypeptide proteins. These proteins may be expected to show intensive inter-chain secondary bonding through the –CO- and –NH- groups but the possibilities are considerably restricted by the side chains, consisting of amino acid residues which occur so frequently along the main chains sufficiently to allow for their accommodation. The polypeptide chains can interact by means of their side-chains to form 'salt-linkages' (ionic in nature) or covalent linkages. These linkages give rise to a network elastic properties of the fibres.

Stretching a fibre by an externally applied load may involve two main processes which may be called bond stretching and chain straightening. Before a bond can contribute effectively to the extension of a fibre, it must be oriented in the direction of the fibre axis and shorter 'chains of bonds' will orient first. The breaking of one bond may allow the stress to pass to another in parallel with it. Reformation of a broken bond is possible when the fibre is released. The breaking and building of bonds involve internal energy changes but these will be mixed up with configurational changes caused by chain straightening and these changes add an entropy term to the elastic force within the fibre.

MATERIALS & METHOD :

Materials :

Muga and Eri cocoons the basic materials for the present investigation were collected from Sualkuchi and Ramdia.

METHODS:

Tensile properties of Muga & Eri fibre under normal condition is studied with the help of an electronically operated tensile tester.

INSTRUMENTATION:

The instrument used for determining the tensile properties was a computerized Fafegraph M Tensile Tester .A schematic diagram of the basic principles of the instrument is given in Fig no 1. The instrument is provided with two electronically operated grips in a vertical alignment ,one above the other,at a a distance of 10 mm.The upper grip is stationary and the lower grip is allowed to move downwards by the application of a force at a constant rate. This function is carried out with the help of a drive unit. The specimen to be measured is placed in between the two grips.

SPECIMEN MOUNTING:

The FAFEGRAPH Mis a very sensitive instrument and the measurement of tensile strength of the fibre specimens were carried out in the single filament form.

A small bundle of finely prepared fibre was taken and about 3 cm long pieces were cut from the bundle .Single filament of the fibre were carefully separated from that cut pieces.

MEASUREMENT:

The application of force on the specimen was carried out by the

instrument upto the breakage the filament. As soon as it breaks ,the instrument automatically stops and resets for next operation.

The denier of different samples were determined experimentally as stated in the next article and values were fed into the computer for calculation of tensile parameters.

The elongation of the fibre specimen was measured in terms of percentage of the original length. Thus, the force –elongation curves obtained may be considered as stress-strain curves for the fibre samples.

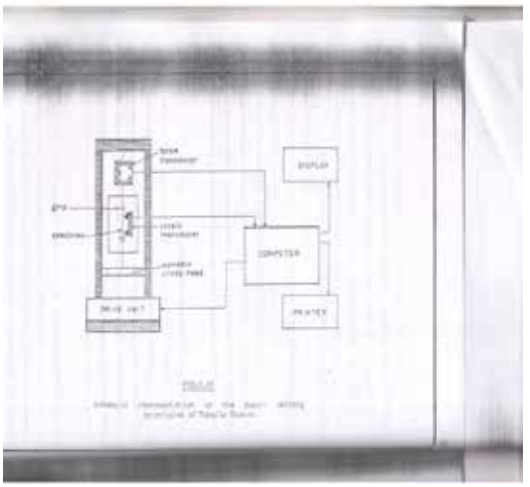

Fig 1: Systematic representation of the basic working principles of tensile tester

RESULT AND DISCUSSION :

Tensile properties of Eri and Muga fibres under normal condition .

FORCE-ELONGATION CURVES FOR NORMAL ERI AND MUGA FIBRES:

The force-elongation curves for normal (degummed) Eri and Muga fibres displayed in Fig. 2 different tensile parameters obtained from the curves for the fibres are given in Table.

Tensile parameters of Eri and Muga fibres :

Samples	Elongation	Average tenacity g/den	Initial modulus g/den
1. Eri	34.51	4.96	1.54
2. Muga	35.80	5.54	2.47

The force-elongation curve for Muga and Eri are comparatively flat. The steepness of a curve may be taken as a measure of the strength of the fibre. The Eri, fibre has low value the fibres under study.

The stretching of a fibre involves two main processes, viz., bond stretching and chain straightening.

Before a bond contributes to the extension of a fibre, it must be oriented in the direction of the fibre axis. Hence the tensile property of a fibre is dependent most closely on the total amount of crystalline material in a preferred direction. The close packing of macromolecules which favours the formation of strong hydrogen bonds between the peptide groups of neighbouring chains and high order of orientation of crystallites. The initial modules for Eri is the low due to its lower value of crystallinity between the two fibres as observed in our X-ray diffraction study.

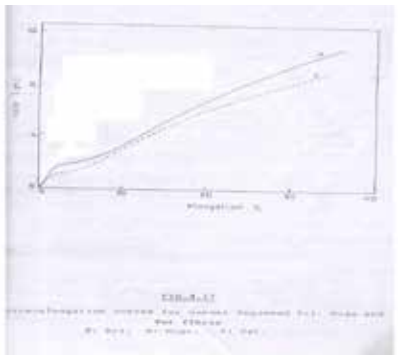

Fig. No. 2 : Force elongation curves for normal degummed Eri and Muga fibres

The extensibility of a fibre is based on the mobility of the chains in the amorphous regions of the structure. Fibres possessing higher degree of crystallinity exhibit lower extensibility. As such, the elongation percent and tenacity for Muga fibre are found to be lower than those for Eri fibre.

The fibres under study possess a short range of elastic limit. They yield at an extension of about 2% and beyond this point they show greater extensions per unit increase in load thereby resulting in flattening of the force-elongation curves. This flow behaviour of the fibres is followed by a hardening, which may ascribed to the reinforcement of the fibres resulting from orientation of the amorphous regions. Eri fibre, having the lowest crystallinity, is much favoured by the amorphous contributions and as much its force-elongation curve is highly flattened.

The tenacity and elongation percent of Muga fibre are found to be high and a considerable flattening of the force-elongation curve is observed though Muga fibre possesses the higher degree of crystallinity between the two fibres as observed in our X-ray diffraction study. This anomalous tensile behaviour of Muga fibre may be ascribed to the spirelling the fibrils about the fibre axis like wool keratin. On applications of an external force, these spriels unfold and thus give rise to a considerable extension in length and flattening of force-elongation curve.

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Quantitative Estimation Of Protein, Carbohydrate And Lipid Contents Of Larval Tissues Of Muga Silkworm (Atheraea Assamensis Helfer) Reared On Two Major Host Plants For Commercial Crop

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Abstract: In the present study, the quantitative changes of protein, carbohydrate and lipid contents in the tissue of various stages of larval instars of Muga silkworm (*Antheraea assama* ww) reared on two major host plants – Som (*Machilus bombycina*,Kost) and Soalu (*Litsaea polyantha* Juss) for commercial crop during autumn season has been estimated. The study reveals that the protein, carbohydrate and lipid contents in all the larval stages of the worm gradually increases through their advancing stages reared on both the host plants. The protein concentration in larval tissue increases from 6.514 mg/dl in third instar larva to 7.042mg/dl in fifth instar larva grown in Som and from 4.185mg/dl to 6.425mg/dl in Soalu grown larva. Similarly, the carbohydrate concentration in larval tissue increases from 29.163 in third instar larva to 34.355mg/dl in fifth instar larva grown in Som and from 27.328mg/dl to 31.504 mg/dl in Soalu grown larva. In the same pattern, the lipid content increases from 0.125mg/dl in third instar larva to 0.228mg/dl in fifth instar larva grown in Som and from 0.195 to 0.248mg/dl in Soalu grown larva. But lipid content in fourth instar recorded more than that of fifth instar larva when reared on Som plants. The concentration of lipid is significantly less in every larval instars in comparison to protein and carbohydrate concentration.

Introduction: Muga silkworm is a multivoltine polyphagous insect and feeds on a wide range of food plants. Som, *Machilus bombycina* King (syn : *Persaea bombycina*) and Soalu, *Litsaea polyantha* (syn : *Litsaea monopetala*) are the two primary food plants. It also feeds on a number of secondary food plants namely Mezankari (*Litsaea citrate*), Dighloti (*Litsaea salicifolia*),

Bogori (*Ziziphus mauritina*) and several others. The commercially exploited muga silkworm is reared six times a year, during October-November (Kotia commercial crop), December-January (Jarua pre-seed crop), February-March (Chatua seed crop), April-May (Jethua commercial crop), June-July (Aherua pre-seed crop) and August-September (Bhodia seed crop). Different nutrients like protein, lipid, carbohydrate, fat and others are used in larval metabolism for silk protein biosynthesis (Unni,1992; Saikia *et al*., 1993; Unni *et al*.,1995a) and other metabolic activities. The quality and quantity of silk fibres of muga silkworm depend mainly on the nutritional material and biochemical constituents of the food plants (Pant *et al*., 1980 and Unni, 1996). The haemolymph protein levels of different Lepidopteran species undergo radial changes (Srivastava and Pareek, 1976). Host plants greatly influence silk production, rate of quantity of food intake, digestion and assimilation, which are directly related to the growth and development of silkworm (Krishnaswami *et al*.,1970;Sinha,*et al*.,2000).Carbohydrate, protein and lipid are the main sources of energy during larval-larval, larval-pupal, pupal-adult transformation and are the major sources of energy (Krishnaswami *et al*., 1978; Thangamani *et al*., 1984). Changing protein profile has been observed during larval, pupal and adult stages of *Bombyx mori*. L (Damara and Gupta, 2010). According to cf. Deuel & Morehouse, 1946; Buck, 1953; Chauvin, 1956 during insect metamorphosis the nutrient reserves of insects may carry out net conversion of fat into carbohydrate. In silkworm *Bombyx mori*.L , after cessation of food intake the glycogen increased concomitantly with decrease in lipid content. There are alleged increase in glycogen content during pupation period of *Bombyx mori* .L (Vaney and Maignon, 1905; Bialascewicz, 1937 and Zaluska, 1959). It is also reported by Frew in 1929 that during pre-pupal and pupal period, the carbohydrate level increases in their non-feeding stages. In the light of the above mentioned considerations, an attempt was made for quantitative estimation of protein, carbohydrate and lipid contents in the tissue of Muga silkworm grown on two major host plants for commercial crop.

MATERIALS AND METHOD:

The larval period of Muga silkworm is completed in five instar stages. In the present work, tissues were taken from third, fourth and fifth instar larvae of specific stages that were collected during autumn period from Govt.Basic Muga Seed Farm, Khanapara. Immediately after collection the larvae were maintained at -20°C wrapped with aluminium foil.

PROTEIN QUANTIFICATION

For protein quantification, the silkworm tissues collected from preferred larval stages were homogenized with PBS (Phosphate buffer saline solution)

in 10% concentration after separating the alimentary canal and then the total protein was precipitated by adding TCA (1:4 in protein : TCA). The precipitated protein was extracted by centrifugation and dissolved with 0.1N NAOH solution and then protein was estimated by Lowry *et al*., (1957) method.

CARBOHYDRATE QUANTIFICATION

For carbohydrate quantification, the silkworm tissues taken from various stages were homogenized with 80% ethanol and then extracted by 52% percloric acid The carbohydrate concentration was then estimated followed by J.E. Hedge *et al.* (1962).

LIPID QUANTIFICATION:

The lipid content of the silkworm tissues of preferred larval stages were extracted by homogenization of the tissue with chloroform : methanol (2:1) and then by methanol:water (1:1) following the method by Folch *et al.* (1957). The lipid was estimated by using Venillin reagent according to Kaufmann and Brown, 2008 with slight modification.

STATISTICAL ANALYSIS

Statistical analysis of the observation was done by using average ± standard deviation between the mean values of the tissue of muga silkworm protein, carbohydrate and lipid content of the Muga silkworm.

RESULT: The concentration of protein, carbohydrate and lipid content in the tissues of third, fourth and fifth instar larvae of Muga silkworm is shown in Table.1

Table 1: The concentration of protein, carbohydrate and lipid content in the tissues of third, fourth and fifth instar larvae of Muga silkworm reared on two host plants (Som and Soalu) for commercial crop (Each value is average ±standard deviation).

Biochemical parameters	Concentration in Som grown larval stages(mg/dl)			Concentration in Soalu grown larval stages(mg/dl)		
	3rd	4th	5th	3rd	4th	5th
Protein	6.51±0.44	6.64±0.34	7.04±0.06	4.18±0.15	6.12±0.19	6.43±0.27
Carbohydrate	29.16±0.64	31.01±0.27	34.35±0.29	27.33±0.32	29.22±0.32	31.50±0.35
Lipid	0.13±0.03	0.37±0.57	0.23±0.02	0.19±0.02	0.24±0.03	0.25±0.02

Concentration of protein:

In both Som and soalu reared larvae, the mean value of tissue protein level increases from third instar larvae to fifth instar larvae with a slightly higher values in all the stages of larvae grown on Som plants. The mean values of the protein content (mg/dl) recorded were 6.51±0.44 in third instar, 6.64±0.34 in fourth instar and 7.04±0.06 in fifth instar larval stages. Similarly, the mean values of the protein content of Soalu grown larval tissues were recorded as 4.18±0.15 in third, 6.12±0.19 in fourth and 6.43±0.27 in fifth instar larval stages of muga silkworm. From the result it was evident that the protein content always maintained low level in the Soalu grown larval tissues than in the tissues of Som grown larvae.

Concentration of carbohydrate:

The concentration of carbohydrate also gradually increases with the advancing stages of Muga silkworm grown in both the host plants. Further, as in case of protein, the carbohydrate content also maintains slightly higher level in Som grown larvae than those grown in Soalu. The concentration of tissue carbohydrate level (mg/dl) recorded in Muga grown larvae were 29.16±0.64 in third, 31.01±0.27 in fourth and 34.35±0.29 in fifth instar stages of Muga silkworm. In Soalu grown larvae, the carbohydrate content recorded were 27.33±0.32 in third, 29.22±0.32 in fourth and 31.50±0.35 in fifth instar larvae.

Concentration of lipid: The lipid concentration in the larval tissues of both Som and Soalu grown worms were found to be very low in comparison to protein and carbohydrate concentration. The levels of lipid concentration recorded were 0.13±0.03 in third instar, 0.37±0.57 in fourth instar and 0.23±0.02 in fifth instar larvae of Muga silkworm grown on Som plant. The lipid contents of different larval stages grown in Soalu plants were recorded as 0.19±0.02 in third instar, 0.24±0.03 in fourth instar and 0.25±0.02 in fifth instar worms.

In Som grown larva, the lipid content was much higher in fourth instar but in Soalu grown larva, the lipid content gradually increased in all the three larval stages of development. A great variation was observed between the silkworm larvae reared on the two different host plants.

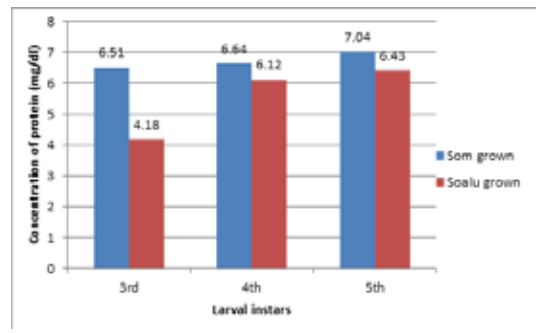

Fig.1: Histogram showing the protein content in silkworm tissue of third, fourth and fifth instar larvae reared on two major host plants- Som and Soalu.

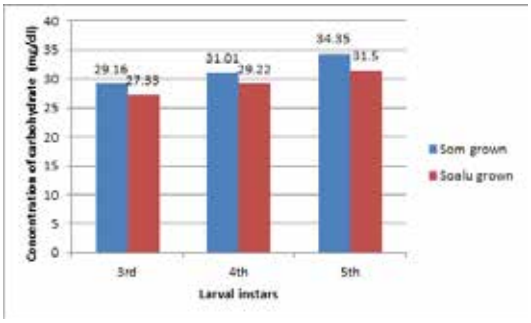

Fig.2: Histogram showing the carbohydrate content in silkworm tissue of third, fourth and fifth instar larvae reared on two major host plants – Som and Soalu.

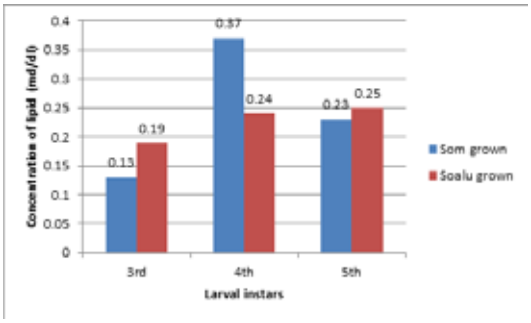

Fig.3: Histogram showing the lipid content in silkworm tissue of third, fourth and fifth instar larvae reared on two major host plants-Som and Soalu.

Discussion:

The result of the present investigation shows that the concentration of protein, carbohydrate and lipid content in the tissues of larval stages of Muga silkworm increases with the advancing stages of larval instars from third to fifth and the lipid concentration was found to be extremely low.

It was observed that the protein content significantly increases from third to fifth instar larva. This difference in protein content in the different larval stages was perhaps due to difference in protein consumption in the metabolic activities of the larval stages. It is also hypothesized that the rate of transforming amino acids of digested food protein into tissue protein is lessened which can be attributed to intracellular transformation of few protein molecules to some other compounds. It can also be interpreted that due to high rate of consumption of food at this stage, tissue proteins may transform into digestive enzymes. The higher protein content in the fifth instar larva must have resulted owing to absorption of higher amount of amino acids from the gut due to increased enzymatic action of protein. Proteins are important biological macromolecules that are required for growth and development of the silkworm as well as biosynthesis of silk. The protein content in the tissue of sericogenic insects is responsible for the formation of silk proteins by their silkglands (Lokesh *et al.*, 2011 and Sabhat *et al.*, 2011).

Wyatt (1967) reported that the carbohydrate content in insects is intimately related to physiological processes such as moulting, metamorphosis and diapause of silkworm larva. The silkworm tissue cannot store large amount of glucose but utilize it as a source of energy for their metabolic activity and the tissue withdraw glucose from the haemolymph which is a large pool of glucose available in

proximity. The glucose level in silkworm haemolymph during their feeding period are relatively low as excess glucose is utilized for glycogen synthesis in the fat body (Firdose *et al.*, 2008). Results of the present study shows that the carbohydrate content of silkworm tissue increases with the increase in larval maturity. This may be due to the increase in feeding habit which can be attributed to its greater metabolic demand.

Lipid content of silkworm larvae was found to increase with the increasing larval stages. However, slight variation was observed as it was found that in Som reared larva, the lipid content of fourth instar was higher than the fifth instar larva. This might be caused due to the difference in lipid metabolism pattern. Unni *et al.* (1995) stated that the secondary host plants of muga silkworm contain low level of lipids as compared to that of primary host plants. The present study also shows that the som grown larva have higher lipid content than the soalu grown larva which can be directly related to the higher levels of lipid present in the Som plants.

High concentration of protein, carbohydrate and lipid was recorded in the larvae reared on Som plants. This might be due to the higher levels of protein, carbohydrate and lipid present in the leaves of Som plants which needs further investigation.

CONCLUSION: From the present investigation it has been concluded that the chief silk synthesizing material protein of silkworm tissue is greatly affected by the feeding habit of silkworm larvae during their larval development. The carbohydrate and lipid content of silkworm is also affected by the feeding habit of silkworm larvae. But in comparison to protein and carbohydrate content, the lipid content was found to fluctuate during the larval stages, i.e, the lipid content increased and recorded highest in the fourth instar stages and then again decreased in fifth instar larval stages.

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Seasonal Effects On Development And Economic Characters Of Muga Silkworm (Antheraea Assma Westwood)

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Abstract

The environmental conditions plays a significant role and influence the quantitative and qualitative characters of silkworm such as larval duration, larval growth, effective rate of rearing, single cocoon weight, shell weight, pupal weight, silk ratio, filament length, denier and reelability of cocoon etc. Larvae of muga silkworm (*Antheraea assma* Ww.) were reared on Som (*Persea bombycina* Kost.) in different seasons / crops namely Katia, Jethua, Bhadia, Chatua, Aherua and Jarua crop. The data were recorded as Larval duration 29.74±0.550 days, 27.26±0.893 days, 25.01±0.076 days, 34.22±0.284 days, 23.28±0.200 days and 46.25±0.396 days; Effective Rate of Rearing by number 57.85x1.110 %, 55.52±0.580 %, 44.42±0.774 %, 42.50±0.590 %, 39.68±l.020 %, 36.15±l.210 %; Single cocoon weight Male 4.890±0.119(gm), Female 7.226±0.399(gm); Male 4.750±0.109(gm), Female 7.175±0.145(gm); Male 4.390±0.393(gm), Female 6.515±0.321(gm); Male 2.875±0.149(gm), Female 4.595±0.285(gm); Male 4.350±0.414(gm), Female 6.389±0.348(gm); Male 3.765±0.430(gm), Female 4.975±0.441(gm); Single shell weight Male 0.484±0.015(gm), Female 0.670±0.071(gm); Male 0.450±0.038(gm), Female 0.655±0.061(gm);

Male 0.420±0.018(gm), Female 0.595±0.041(gm); Male 0.243±0.040(gm), Female 0.362±0.020(gm); Male 0.395±0.064(gm), Female 0.560±0.058(gm); Male 0.332±0.015(gm), Female 0.395±0.051(gm); Shell Ratio Male 9.897±0.221(%), Female 9.272±0.629(%); Male 9.663±0.723(%), Female 9.129±0.866(%); Male 9.567±0.637(%), Female 9.132±0.332(%); Male 8.452±1.078(%), Female 7.878±0.289(%); Male 9.080±1.032(%), Female 8.765±1.087(%); Male 8.818±0.731(%), Female 7.940±0.690(%); filament length 589.00±5.910m, 407.00±4.620m, 390.60±8.130m, 278.00±6.928m, 450.60±9.710m, 256.30±6.020m in Katia, Jethua, Bhadia, Chatua, Aherua and Jarua crop respectively. The highest non breakable filament length was found in Katia crop and lowest in Jarua crop. Denier 5.40±0.042, 5.20±0.117, 4.77±0.047, 4.38±0.019, 4.72±0.023 and 4.47±0.016; Reelability 91±0.943(%), 91±0.816(%), 88±1.633(%), 84±1.054(%), 87±1.633(%) and 80±1.247(%) in Katia, Jethua, Bhadia, Chatua, Aherua and Jarua crop respectively.

INTRODUCTION

Assam is the homeland for natural silk of fine texture. It was very much demanding Europe and formed a trade of the East India Company during the 18th through early 19th centuries. The custom house at Haida opposite Goalpara, fixed a duty fees of 10% according to the terms of commercial treaty executed with Gaurinath Singh by Captain Welsh on behalf of East India company in 1793 A. D. Around 224 mounds of Muga silk thread were exported and the value was placed at Rs. 53899.00 during that period (Gait, 1905). The muga silk, peculiar to the country, affords the dress which is considered rich and valuable (Robinson, 1941, Barua, B.K., 1969). The chief jungle products of the Goalpara districts are bees wax and dyes; but it is supposed that fibre are to be found, and that will be that these will be form an article of trade (Hunter, W.W. 1998). The first official records of Muga silkworm and Muga silk culture appeared in 1662. The culture of silkworm could be traced out from the notes of great writer Shihabuddin tallish, who was accompanied by Mirjumla at the time of invasion of Assam, (Guwahati was occupied on 4th Feb, 1662). There was mention in his describing on the dresses, the people of Assam used. The collection of official papers issued by the Bengal Board of Trade in 1819 mentioned of mooga (Muga) being the most common and plentiful, the thread coarse but winds easily. The gutis (cocoon) were sold direct from the forest. This was mentioned separately from 'tussah' (tasar) silk so that its very feasibility was intended to denote muga silkworm (Watt, 1893).

Muga silkworm *Antheraea assama* Westwood is endemic polyphagous insect and feeds on a wide range of different food plant species mainly Som (Assamese) locally known (Bennet,

1887) [*Persea bombycina* (King ex Hook. f.) Kosterm, formerly named as *Machilus bombycina* (King ex Hook. f.)], Soalu (*Litsea monopetela* Roxb.= *polyantha* Juss.) and few other food plants. Som is one of the major consumed species throughout North Eastern India for muga silkworm rearing that produces natural muga (Assamese), or golden silk nowhere in the world (Chowdhury, 1982).

The muga silkworm is multivoltine in nature, having five to six generations, successive broods in a year in which the worms were bred and spun cocoons are designated in the Assamese calendar as 'Jethua', 'Aherua', 'Bhadia', 'Katia', 'Jarua' and 'Chatua' corresponding to the months of April-May, June-July, July-August, September-October, November-December and February-March, respectively, (Watt,1893; Robinson,1941); Chowdhury,1964c, 82, 92; Bharali, 1968, 69, 70b, 71;Gogoi,1977, 79a; Borah *et al.*,1988; Thangavelu *et al.*,1988; Subha Rao,1998; Sahu *et al.*,2000). The commercial crops during autumn and spring namely 'Katia' and 'Jethua' producing quality silk and the other seed crops were Jarua, Chatua, Aherua and Bhadia, (Subha Rao, 1998). 'Aherua' and 'Bhadia' seed broods were reared chiefly in Kamrup district and some part of Goalpara district (Watt, 1893). Occasionally 'Bhadia' brood of inferior quality was reared in Sibsagar on high lying patches.

The larvae are reared in different photoperiodic regimes; the effect of temperature can influences the effect of photophase during the developmental period. High temperature and constant light as well as low temperature and short photophase are deleterious with respect to food utilization and growth. The sensitivity to photoperiod decreases towards fifth instars when the larvae are more sensitive to temperature. This sensitivity of the insect to light and temperature may help to formulate conservation strategy (Bora, 2006).

The rearing parameters i.e. larval duration, effective rate of rearing, melting percentage; cocoon characters i.e. single cocoon weight, shell weight, shell ratio; reeling parameters i.e. average filament length, denier, rendita, reelability percentage are depend upon the ideal environmental condition i.e. 23°C temperature and 70% relative humidity during the spinning of mulberry silkworm CSR hybrids CSR2 x CSR4 and CSR2 x CSR5 (Rahman, 1999).

The climate of Goalpara district is very hot and humid in summer and dry cool in winter. On the basis of temperature and rainfall the season of the place is divided mainly into winter, pre-monsoon, monsoon and summer. The maximum temperature is up to 38° Celsius and minimum, 8° Celsius during summer and winter respectively. The average relative humidity is 51.1%-91.2% at day and 35.3-%-75.2% at night during summer and winter respectively (Taher

and Ahmed, 2001). Various factors i.e. temperature, humidity, photoperiod and air current influence the physiological activities affecting their growth and development as well as the expression of economic traits (Kogure, 1933). The silkworm is cold blooded (Poikilothermic) insect and by nature quite delicate and very sensitive to the environmental condition. Therefore, silkworm rearing has a certain amount of risk invariably experienced by sericulturists as it is greatly influenced by the environmental factors, i.e. temperature, humidity, photoperiod and air current from incubation to cocooning Tazima, (1978).

Hence, it is essential to ascertain the seasonal effect of environmental condition in different crop which is the best for rearing of muga silkworm to get higher production and quality of silk an ultimate goal to increase the production and productivity of the cocoon per unit area and time with low cost of production for improving economic condition of the poor sericulture farmers. In this context the present study has been undertaken.

MATERIALS AND METHOD

The study of seasonal effects on the growth, development and economic characters of Muga silkworm and experiments pertaining to some aspects of its were carried out in Govt. Sericulture Farm, Agia, Goalpara district and Govt. Muga Reeling Unit Khanapara, Assam, India, different seasons from February, 2012 to January, 2015.

The general method of outdoor rearing of muga silkworm was followed as recommended by Bharali, (1970) and Choudhury, (1982). The rearing was conducted in six different crops/ seasons and observations were made on different aspects of silkworm growth and rearing performance, cocoon parameters. Cooking and reeling of muga cocoons were done by method suggested by Chowdhury, (1970b) and Rathi *et. al.*, (1988).

The experiment was laid out in completely randomized design. The data were statistically analyzed by Fisher's methods of analysis of variance following Panse and Sukhatme (1989).

Figure: Study Area Govt. Sericultural Farm, Agia, Goalpara district, Assam

RESULTS AND DISCUSSION

The study reveals that there are

considerable variations in rearing performance and cocoon characters when the muga silkworm reared in different seasons/ crops. The growth, development of muga silkworm and the economic characters in all crops are not equal. The growth, development of muga silkworm and the economic characters of muga silkworm reared in all the different seasons on Som are recorded as below.

Larval period

The larval period is directly correlated with the surrounding environmental conditions specially temperature and relative humidity prevailing during the rearing. The larval duration was recorded 29.74±0.550 days in Katia crop, 27.26±0.893 days in Jethua crop, 25.01±0.076 days in Bhadia crop, 34.22±0.284 days in Chatua crop, 23.28±0.200 days in Aherua crop and 46.25±0.396 days in Jarua crop. The shorter larval duration was found in Aherua crop and longer larval duration was in Jarua crop (Table 1, Figure1). Similar study made by some authors Kakati *et al*., 2004 and found that the larvae complete within 20-25 days in summer and 45-55 days in winter. Watt (1893) mentioned the minimum and maximum periods were 26-40 days in larval stage. Chowdhury, (1982) reported that 24-70 days in larval stage.

Full grown larval weight

Table 1 & Figure 2 show the full grown larval weight of muga silkworm. The fully mature larva attains male 8.640±0.090 gm, female 13.100±0.495 gm in Katia crop, male 8.490±0.033 gm, female 12.525±0.069 in Jethua crop, Male 6.540±0.559gm, female 12.245±0.141 in Bhadia crop, male 6.940±0.011gm, female 10.950±0.030 gm in Chatua crop, male 6.343±0.136 gm, 12.230±0.048 gm Aherua crop and male 8.550±0.275, 12.690±0.037 in Jarua crop. The highest grown observed in Katia crop and lowest in Chatua crop. Generally the female larvae are larger and heavier than the male larvae.

Effective rate of rearing

Yield was recorded during all the crops (Table 1, Figure 3). The highest ERR by number was 57.85x1.110 % during Katia crop followed by 55.52±0.580 in Jethua crop, 44.42±0.774 in Bhadia crop, 42.50±0.590 in Aherua crop, 39.68±l.020 in Chatua crop and lowest 36.15±l.210 in Jarua crop. Similar results were reported by Siddiqui *et al*., (2000).

Table 1: Total larval period (days), Full grown larval weight (gram) and Effective rate of rearing (ERR) of muga silkworm in different crops

Crop/ Season	Total larval period (days)	Full grown larval weight (gram)		Effective rate of rearing
		Male	Female	
Katia	29.74±0.550	8.640±0.090	13.100±0.495	57.85x1.110
Jethua	27.26±0.893	8.490±0.033	12.525±0.069	55.52±0.580
Bhadia	25.01±0.076	6.540±0.559	12.245±0.141	44.42±0.774
Chatua	34.22±0.284	6.940±0.011	10.950±0.030	39.68±l.020
Aherua	23.28±0.200	6.343±0.136	12.230±0.048	42.50±0.590
Jarua	46.25±0.396	8.550±0.275	12.690±0.037	36.15±l.210

Data represent means of 3 replications (10 individuals/replication)

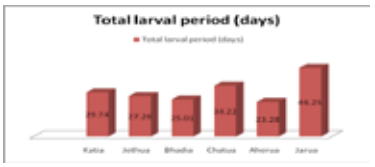

Figure 1: Total larval period (days) of muga silkworm in different crops

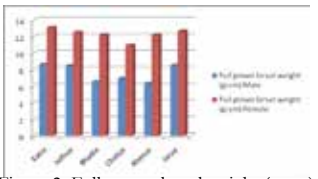

Figure 2: Full grown larval weight (gram) of muga silkworm in different crops

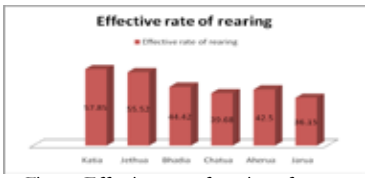

Figure: Effective rate of rearing of muga silkworm in different crops

Single cocoon weight

The results are presented in the Table 2 & Figure 4. A perusal of the data of table 2 that the maximum cocoon weight male and female have been obtained from the cocoons reared in Katia crop and lowest in Chatua crop. The Jethuwa and Khotia (Katia) were the best crops as to quality and quantity. The 'Aheruwa' and 'Bhadia' yielded a small quantity of inferior of silk (Robinson, 1941),

Single shell weight

The shell weight of different crops were recorded and presented in the table 2 and figure 5. The maximum shell weight male 0.484±0.015 gm, female 0.670±0.071 gm have been obtained from the cocoons reared in Katia crop and lowest male 0.243±0.040 gm and female 0.362±0.020 in Chatua crop.

Shell Ratio

The shell ratio was recorded and presented in table 2 & figure 6. Highest muga cocoon shell ratio was found male 9.897±0.221 %, female 9.272±0.629 % in Katia crop and lowest was male 8.452±1.078 % female 7.878±0.289 % in Chatua crop.

The cocoon productions in different seasons are not uniform in their commercial characters. The cocoon weight varies from 2.6-8.6gm, shell weight from 0.2-0.76gm, shell ratio percent from 4.7-10.5 %, (Borah *et al.*, 1988). Thangavelu, (1988) found that cocoon weights were to be 4.1gm, 5.2gm, 4.5gm, 4.5gm, and 5.8gm shell weights were 0.28gm, 0.48gm, 0.35gm, 0.35gm and 0.57gm in 'Chatua' 'Jethua', 'Aherua', 'Bhadia', 'Katia' respectively.

Table 2: Single cocoon weight, Single shell weight and Shell Ratio of muga silkworm reared in different crops.

Crop/ Season	Single cocoon wt (gm)		Single shell wt (gm		Shell Ratio (%)	
	Male	Female	Male	Female	Male	Female
Katia	4.890±0.119	7.226±0.399	0.484±0.015	0.670±0.071	9.897±0.221	9.272±0.629
Jethua	4.750±0.109	7.175±0.145	0.450±0.038	0.655±0.061	9.663±0.723	9.129±0.866
Bhadia	4.390±0.393	6.515±0.321	0.420±0.018	0.595±0.041	9.567±0.637	9.132±0.332
Chatua	2.875±0.149	4.595±0.285	0.243±0.040	0.362±0.020	8.452±1.078	7.878±0.289
Aherua	4.350±0.414	6.389±0.348	0.395±0.064	0.560±0.058	9.080±1.032	8.765±1.087
Jarua	3.765±0.430	4.975±0.441	0.332±0.015	0.395±0.051	8.818±0.731	7.940±0.690

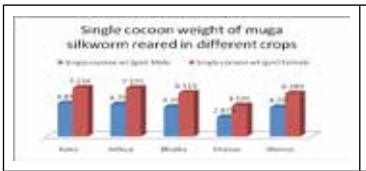

Figure 4: Single cocoon weight of muga silkworm reared in different crops

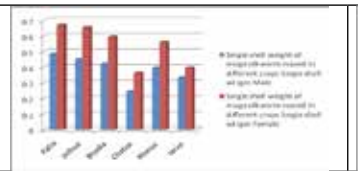

Figure 5: Single shell weight of muga silkworm reared in different crops.

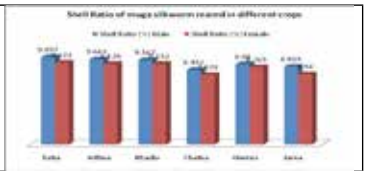

Figure 6: Shell Ratio of muga silkworm reared in different crops.

Average filament length

The continuous length of filament is very important character for commercial silk. Average length of the filament was taken out and calculated for single cocoon producing the filament in meter. Maximum filament length found 589.00±5.910m in Katia, 407.00±4.620m in Jethua, 390.60±8.130m in Bhadia, 278.00±6.928minChatua,450.60±9.710m in Aherua, 256.30±6.020m in Jarua crop (Table 3 & Figure 7). The reelable single cocoon filament length from 221-556 metre (Borah *et al*., 1988), the filament length were 204m, 400m, 225m, 300m and 500m in 'Chatua' 'Jethua', 'Aherua', 'Bhadia', 'Katia' respectively Thangavelu, (1988).

Non breakable filament length

The table 3 & figure 8 shows the non breakable filament length (NBFL). The highest non breakable filament length was found in Katia crop and lowest in Jarua crop.

Average Filament size (Denier)

Denier is inversely proportional to rendita which is also a very important parameter to decide the rate of reeling cocoons. The denier of muga silkworm reared on different season recorded and presented in table 3 & Figure 9.

Reelability

The data represented in table 3 & figure 10. The reelability is highest in Katia but lowest in Jarua crop.

Table 3: Total filament length, Non breakable filament length, Denier and Reelability of muga silkworm reared in different crops.

Crop/ Season	Total filament length (m)	Non breakable filament length (m)	Denier	Reelability (%)
Katia	589.00±5.910	482.00±8.393	5.40±0.042	91±0.943
Jethua	407.00±4.620	383.20±1.590	5.20±0.117	91±0.816
Bhadia	390.60±8.130	335.10±16.454	4.77±0.047	88±1.633
Chatua	278.00±6.928	154.10±10.447	4.38±0.019	84±1.054
Aherua	450.60±9.710	302.00±:4.080	4.72±0.023	87±1.633
Jarua	256.30±6.020	135.50±8.963	4.47±0.016	80±1.247

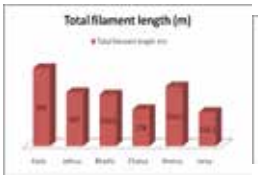

Figure 7: Total filament length of muga silkworm reared in different crops.

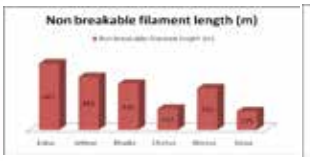

Figure 8: Non breakable filament length of muga silkworm reared in different crops

Figure 9: Denier of muga silkworm reared in different crops

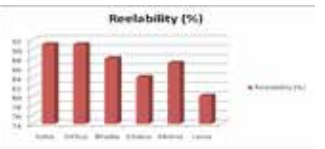

Figure 10: Reelability of muga silkworm reared in different crops

Conclusion

India is a tropical country and environmental conditions are the limiting factors of muga silkworm rearing. Majority of muga rearers encounters the various environmental problems and lose their crops or produce inferior quality of cocoon and silk. Based on the experiments and findings, the inference drawn in it is given below:

❖ The effective rate of rearing, larval weight, larval duration, cocoon weight, shell weights, denier, and reelability significantly depends on environmental conditions.

❖ Jarua crop (Dec-Jan) low temperature and low humidity conditions rearing should be avoided as larvae unable to take leave, hence, larval period increases significantly. Aherua crop (Jun-Jul), high temperature (34-36 °), high humidity (81-91%) during rearing to be avoided as the larvae become imbalance physiologically and susceptible to diseases due to their fluctuations, water stagnation in rearing field leading to high humidity, Wastage of early stage worms due to heavy rain and hailstorms, high incidence of pest and predators like ants, spiders, bugs, wasps, birds etc, high incidence of bacterial and viral diseases. During pre-seed and seed crops the climatic conditions mostly remain unsuitable with high incidence of diseases and heavy infestation of pest and predators.

By all the above modifications and suggestions, muga silkworm rearing may be conduct and quality of cocoons and silk can be improved where environmental variation is more.

Acknowledgement

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Lemon Butterfly (Papilio Demoleus Linnaeus) As A Pest Of Curry Leaf Plant (Murraya Koenigii Linn. Sprengel)

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Abstract

The curry leaf plant (*Murraya koenigii* Linn. Sprengel) (*Narasingha* in Assamese) is cultivated for its aromatic leaves. The leaves, bark and root of the plant are used in the indigenous medicine as a tonic, stimulant, carminative and stomachic. In spite of the fact that their strong smell deters most pests, some insects is a problem for curry leaves. A total of 12 insect-pests of curry leaf plant belonging to 10 families of 5 insect orders were recorded in India. Lemon butterfly is one of the important pests of curry leaves. The lemon butterfly, *Papilio demoleus* Linnaeus, ranges widely and is an extremely successful invader. The adult butterflies feed on the nectar of a variety of flowering plants and shrubs such as the ubiquitous Lantana with its plentiful blooms. In India it is mostly found in the plains but can be found on the hills of peninsular India and up to 7000 feet in the Himalayas. The number of generations of *Papilio demoleus* is dependent upon temperature and in warm temperate, five generations have been recorded.

Lemon butterfly was found to be a serious pest of curry leaves in some areas of Nagaon district of Assam. The pest defoliated the entire plants of the localities damaging a flash of the leaves. Only one generation of the pest was found infesting the curry leaves causing 50.61% of crop damage during 2012. After that the larvae underwent pupation. Grayish yellow eggs are laid singly on the leaf surface, IP- 4-5 days, LP- 13-23 days and PP- 8-13 days. Early instars larvae resemble bird droppings. Late instars dark green, stout with a pair of hidden red osmetorium which emits

defensive secretion when disturbed. The pupa, chrysalis, is dimorphic with regards to colour, with the colour developing according to the prevalent colour and texture in the background. The colour of pupae in the leaves was pale green while the colour of the pupa in the dead plants or walls was like dry leaves. This valued plant can be protected from lemon butterfly through hand picking of larvae.

Keyword:Curry leaf plant, lemon butterfly, larva, dimorphic, hand picking

Introduction

The curry leaf plant (*Murraya koenigii* Linn. Sprengel) is a tropical to sub-tropical tree in the family Rutaceae, which is native to India. The *P. demoleus* is known to feed on virtually all species and varieties of native or introduced citrus and other members of Rutaceae family including *Aegle marmelos* (Bael fruit) and *Murraya koenigii* (Indian curry-leaf tree). The New World arrival of this pest is a potential threat to the citrus industries in the region. The larvae are a serious pest of citrus nursery stock (trees 1-2 ft. in height) and other young citrus trees in Asia and the Middle East. Larvae may utilize young leaf flush on more mature trees. Potential threat to other members of Rutacae family including curry leaf plant. The curry leaf plant is named differently in different languages. In Assamese it is called *Narsingha; Kathnim, Mitha neem, Curry patta, Gandhela, Bareanga* in Hindi; *Barsanga, Kariphulli* in Bengali; *Goranimb, Kadhilimbdo* in Gujarati; *Karibevu* in Kannada; *Karriveppilei* in Malayalam; *Karhinimb*, *Poospala*, *Gandla, Jhirang* in Marathi; *Barsan, Basango, Bhuraunga* in Odisha; *Curry patta* in Punjabi; *Krishna nimbi* in Sanskrit; *Karivempu, Karuveppilei* in Tamil and *Karepaku* in Telugu. Curry leaf is found almost throughout India up to an altitude of 1500 metres. It is much cultivated for its aromatic leaves. The plant is a shrub or small tree, growing 4–6 m (13-20 feet) tall, with a trunk up to 40 cm diameter. The leaves are pinnate, with 11-21 leaflets, each leaflet 2–4 cm long and 1–2 cm broad. They are highly aromatic. The leaf is used in South India as a natural flavouring agent in various curries. Volatile oil is used as a fixative for soap perfume. The leaves, bark and root of the plant are used in the indigenous medicine as a tonic, stimulant, carminative and stomachic. They are much valued as an anti-diabetic, antioxidant, anti-hypercholesterolemic, antimicrobial, anti-inflammatory, hepatoprotective, etc (Arulselvan and Subramanian, 2007). In spite of the fact that their strong smell deters most pests, some insects is a problem for curry leaves. A total of 12 insect-pests of curry leaf plant belonging to 10 families of 5 insect orders were recorded in India. Lemon butterfly is one of the important pests of curry leaves. The lemon butterfly, *Papilio demoleus* Linnaeus, ranges widely and is an extremely successful invader. The adult butterflies feed on the nectar of a variety

of flowering plants and shrubs such as the ubiquitous Lantana with its plentiful blooms. In India it is mostly found in the plains but can be found on the hills of peninsular India and up to 7000 feet in the Himalayas. The number of generations of *Papilio demoleus* is dependent upon temperature and in warm temperate, five generations have been recorded.

Fig. 1. Lemon butterfly larva in curry leaf

Fig. 2. Pupa in curry leaf plant

The New World arrival of this pest is a potential threat to the citrus industries in the region (Eastwood *et. al.*, 2006). The larvae are a serious pest of citrus nursery stock (trees 1-2 ft. in height) and other young citrus trees in Asia and the Middle East. Larvae may utilize young leaf flush on more mature trees and emerge as potential threat to other members of Rutacae family including curry leaf plant (Tara and Sharma, 2010).

Materials and Methods

Lemon butterfly was found as most serious pest of curry leaves in some areas of Nagaon district during March, 2012. Some places of Haiborgaon areas were surveyed. Data were simply collected from few randomly selected plants by counting the infested and non-infested plant and the intensity of the lemon butterfly attack was worked out. For the biological study of the pest, the larvae were reared in the laboratory on curry leaf plant.

Result and discussion

The pest defoliated the entire plants of the localities damaging a flash of the leaves. Only one generation of the pest was found infesting the curry leaves. Out of 81 plants observed 41 plants were found damaged. Average 50.61% of plant was found damaged. Some of the damaged plants were completely defoliated. The adults range in wingspan from 80-100 mm. The adults range in wingspan from 80-100 mm. The upper portion of the forewing is largely black and the outer wing margin has a series of

irregular yellow spots. Two yellow spots are present at the upper end of the discal cell with several scattered yellow spots in the apical region. The adults fly in every month but are more abundant after monsoons. The eggs are pale yellow, nearly spherical, about 1.5 mm, basally flattened, and smooth. Females lay eggs singly near the edges of the food plant leaves. Incubation period was 4-5 days. Early instars larvae resemble bird droppings (Fig. 1). Late instars dark green, stout with a pair of hidden red osmetorium which emits defensive secretion when disturbed. Larval period was 13-23 days. The pupa, chrysalis, is dimorphic with regards to colour, with the colour developing according to the prevalent colour and texture in the background (Fig. 2). Pupal period was 8-13 days. Adult period was 4-6 days. Total life cycle ranged from 29 to 47 days.

Conclusion

This valued plant can be protected from lemon butterfly through hand picking. Biological control agents also play critical role in protecting the curry leaf plant from this pest. Three larval parasitoids are known to parasitize *P. demoleus* larvae in India. They are *Apanteles papilionis*, *Apanteles* sp. and *Bracon hebetor* (Hymenoptera: Braconidae). The biopesticides *Bacillus thuringiensis (*Bacterium*)* and *Beauveria bassiana* (fungus) were shown to have effects on *P. demoleus* in India and *Bacillus thuringiensis* showed the highest effect. Neem seed kernel extract and azadirachtin are also known to protect the plant from lemon butterfly.

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Evaluation Of Fecundity Rate Of The Three Sisor Sp. Found In The Brahmaputra Basin

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ABSTRACT

Fecundity of the three species of *sisor rabdophorus, Sisor chennuah, Sisor brakenesis* found in the Manas river located in the Borpeta District of Assam. The species of *Sisor* breeds in the month of the April to the month of August. During this period they breed and attains their stage of maturity. The rate of fecundity of the three species differ in the form of ovary weight and number of the eggs present. Morphologically the three species are identical but they have difference in the fecundity rate.

KEYWORDS: *Sisor rabdophorus,Sisor chennuah, Sisor brakenesis* Manas river, ovary weight.

Introduction

Fecundity can be defined as the number of ova that are likely to be laid by a fish during spawning seasons. Fecundity is a measure of the reproductive capacity of a female fish and can be defind as "the number of ova that are likely to be laid by a fish during the spawning season".

Fecundity is a valuable population parameter because it provides some insight into a population 's reproductive potential .Fecundity is a measured on individual fish but typically expressed as a function of body length and data for the entire population plotted. The curve or equation that results can be used predicts fecundities from lengths .Potential egg production of a fish population can be estimated from knowledge of fecundity, a population can be estimated from knowledge of fecundity ,a population's age structure and sex ratio and population's age structure and sex ratio and population abundance. Spawaning is generally synchronized with water temperature and photoperiod.

It has been observed by previous workers that the fecundity of a fish varies with the size. Most of them (Kisselevith,1923; and

Clark, 1934) held the view that fecundity of a fish increases in proportion to the square to its length. Simpson (1951) pointed out flaws of such a conception in the view of the fact that egg production in an ovary is not a surface phenomenon and that the germinal epithelium is so folded as to fill the volume of the ovary .He, therefore concluded on the basis of his study of the fecundity of the place that number of egg is related to the volume and consequently to the cube of the length.

For the determination of the fecundity of *Sisor* ovaries of 150 species ranging from 9cm to 20 cm were studied. Only ovaries containing nearly mature eggs were used for this study. All possible precautions were used for this study. All possible precautions were taken to exclude spent fish or fish that were insufficiently mature .The ovaries were hardened in 5% formaldehyde for a period of not less than a week before estimating the number of ova in each. Only ova visible to the naked eye were counted. After removal of the surface moisture ,ovaries were weighted to the nearest milligram in a chemical balance. A Small sample of approximately 2.0 gm was removed from the central portion and weighted to the nearest milligram .The ova in the sample were teased the follicle and counts were made of all ova composing the mature growing visible to naked eye .The total number of ova was calculated for each specimen, by multiplying the calculated number of ova in the sample by the ratio of the total weight of ovary to the weight of sample.

Observation :

Table 1.1 explain the relation between fish weight and fecundity of *Sisor* .It was observed that the more heavier fish yield more nos of ova. It was again observed that more fish results weight results more ovary weight and yield more nos of mature ova .Table 2 implies the relation between fish length ,ovary length and fecundity of *Sisor*. It was seen that fish ranging 9-20 cm. in length

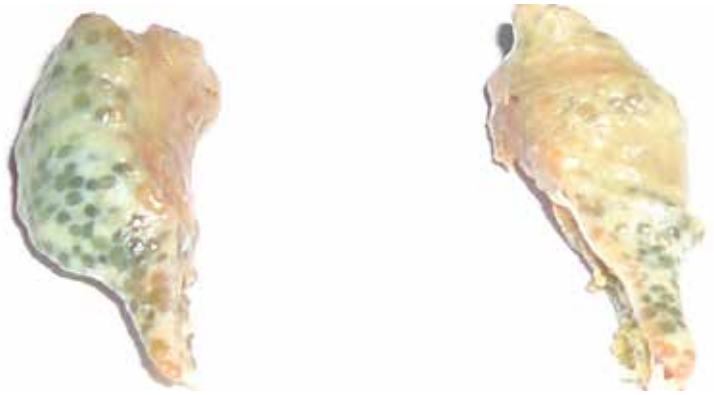
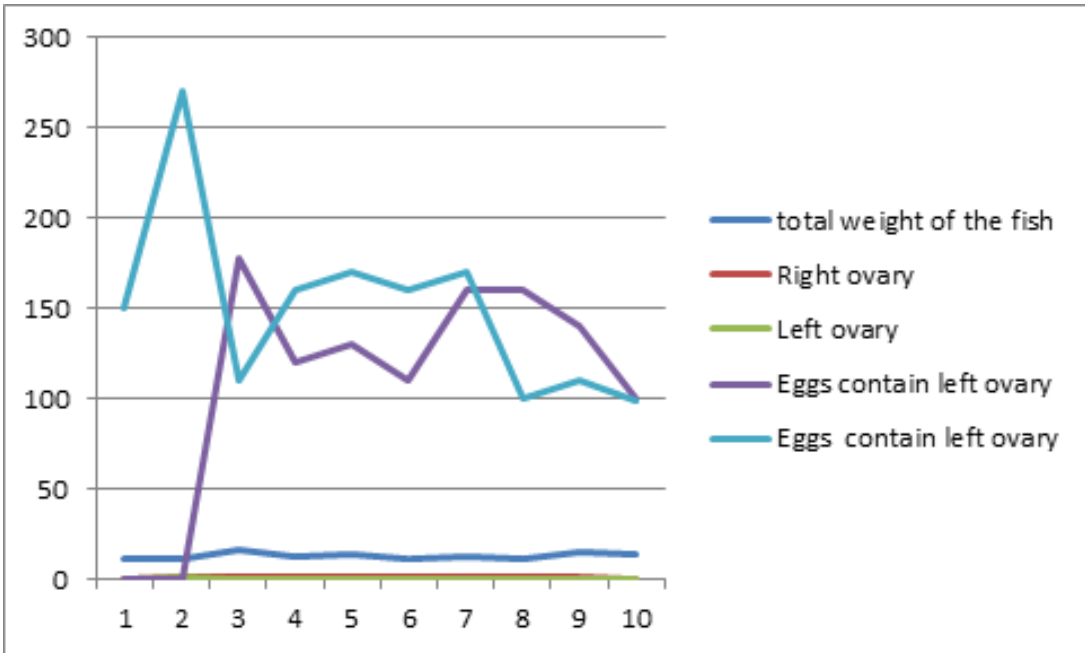


Fig ovary of *sisor rabdophorus*

Sample no	Total wt of the fish	Right ovary	Left ovary	Eggs contain left ovary	Eggs contain right ovary
1	11.417gm	0.524gm	0.522gm	110eggs	150eggs
2.	21.41gm	1.249gm	1.00gm	250eggs	270eggs
3.	15.79gm	1.838 gm	0.688gm	178eggs	110eggs
4.	12.341gm	1.765gm	0.533gm	120 eggs	160eggs
5.	13.431gm	1.789gm	0.564gm	130eggs	170 eggs
6.	11.452gm	1.762gm	0.544gm	110 eggs	160eggs
7.	12.455gm	1.246g	0.567gm	160 eggs	170 eggs
8.	11.563gm	1.356gm	0.564gm	160 eggs	100eggs
9.	15.45 gm	1.568gm	0.567gm	140eggs	110eggs
10.	13.432gm	0.526gm	0.511gm	100eggs	99eggs

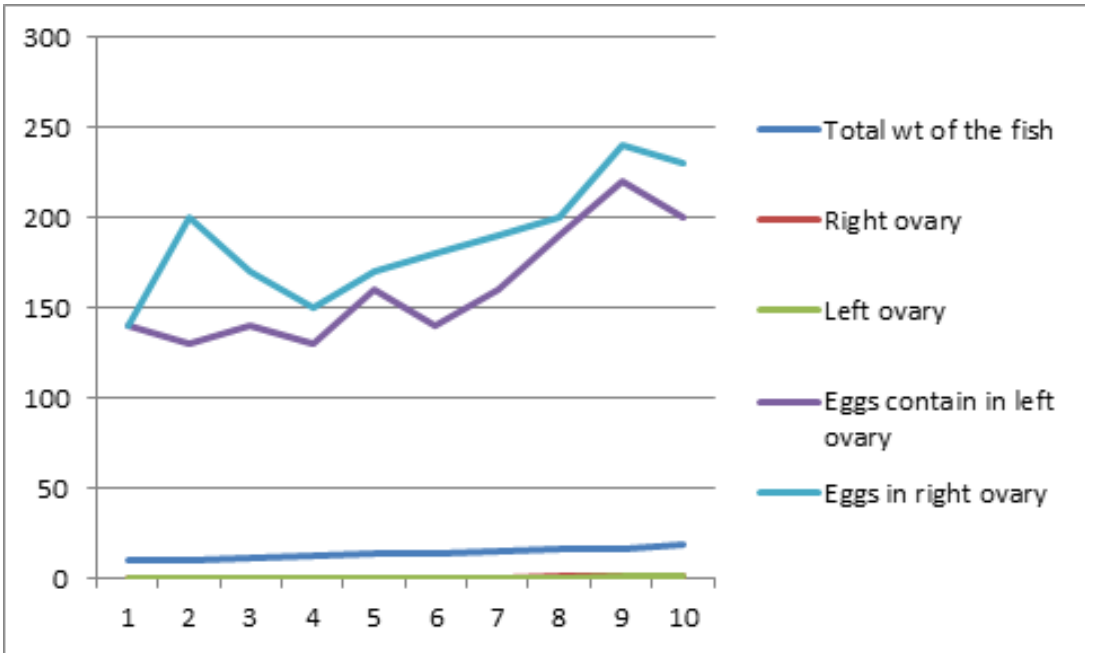
Table: Fecundity of sisor rabdophorus



Sample no	Total wt of the fish	Right ovary	Left ovary	Eggs contain left ovary	Eggs contain in right ovary
1.	10.452gm	0.533gm	0.544gm	120eggs	140 eggs
2.	10.434gm	0.543gm	0.545gm	13o eggs	200 eggs

3	11.433gm	0.448gm	0.634gm	140eggs	170eggs
4	12.456gm	0.522gm	0.643gm	130eggs	150eggs
5	13.348gm	0.455gm	0.344gm	160 eggs	170eggs
6	14.34gm	0.344gm	0.323gm	140eggs	180eggs
7	15.348gm	0.678gm	0.434gm	160 eggs	190eggs
8	16.768gm	0.789gm	0.543gm	190eggs	200eggs
9	17.543gm	0.945gm	0.645gm	220eggs	240eggs
10	19.435gm	1.456gm	0.954gm	200eggs	230eggs

Table: Fecundity of sisor brakenesis



Sample no	Total wt of the fish	Right ovary	Left ovary	Eggs contain left ovary	Eggs contain in right ovary
1.	8.456gm	0.456gm	0.34gm	140eggs	120eggs
2	9.435gm	0.543gm	0.443gm	130eggs	120 eggs
3	7.345gm	0.345gm	0.442gm	140 eggs	130 eggs
4	8.657gm	0.54gm	0.432gm	150 eggs	170eggs
5	9.568gm	0.658gm	0.465gm	170 eggs	180eggs
6	9.435gm	0.789gm	0.456gm	180eggs	190 eggs
7	8.435gm	0.678gm	0.789gm	190eggs	210 eggs

8	9.345gm	0.567gm	0.657gm	210eggs	220eggs
9	7.435gm	0.77gm	0.654gm	220eggs	240eggs
10	8.678gm	0.768gm	0.678gm	230eggs	260eggs

Table:Fecundity of Sisor chennuah

The table shows that the three species of Sisor has show different fecundity rate .The three species show differences in body weight, ovary weight , number of eggs.

Discussion: The above table result that the three species of *Sisor* shows that fecundity of the three species differ from each other. The three species show different in total weight, no of eggs contain etc. Thus the three species of *Sisor* show the different fecundity rate. . Some fishes exhibits distinct sexual dimorphism , while others do not. However *Sisor rabdophorus* shows a distinct sexual dimorphism. In the normal state the adult male *Sisor rabdophorus* shows more elongated Pseudocopulatory papilla was recognizable between the male and female *Sisor* species .In the male papilla is better developed ;it is longer ,narrower and has a definite shape with the distal end more pointed while in the female it is relatively much broder and flush with the body surface .During the breeding seasons the papilla of the mature spawning female becomes swollen .Generally male and females are can be differentiated with the help of the presence variation in the size of the male and female.

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Floristic Diversity Of Greater Sualkuchi Area Under Kamrup District Of Assam

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ABSTRACT

An investigation was carried out during the year 2013 - 2014 in sualkuchi area of district Kamrup, Assam to evaluate the present status of angiospermic plant diversity of the area. During the period of survey a total 313 numbers of angiospermic plant species belonging to 236 genera of 94 families were recorded. Out of them 255 species are Dicotyledons under 73 families and 58 species are from Monocotyledons under 21 families were recorded. The findings of this study are expected to provide a baseline information on plant biodiversity of the area.

Key words: Sualkuchi area, Angiospermic plant diversity.

INTRODUCTION:

Assam is a highly humid tropical region with heterogenic physiography bears a separate identity phytogeographically with a number of types of Plant communities. This is due to its varied climatic conditions (Rainfall - ranging from 850 mm. To 2500 mm per anum, Temperature - ranging from 5° to 38° Celsius and Relative Humidity varied from 73 % to 95 % annually). Assam may rightly be called as the Floristic Gateway of India for its richness of vegetable wealth and diversity of Vegetation and Flora. The major type of plant communities can be grouped under Moist Evergreen Forest, Moist Semi-evergreen, Moist and Dry Deciduous Forest, Hydrophytes in vast stretches of Wetlands (Riparian belt, Swamps and Marshes), Bamboo brakes, Degraded or Scrublands, Grasslands and Savannah (both wet and dry) in alluvial plains.

The richness of plant diversity attracted the attention of a number of Botanist from the earlier periods. French Buchanan pioneered the botanical collection around Guwahati in 1808-1809. Other contributors were Hooker (1872 - 1897), Kanjilal *etal* (1934 - 1940), Rowntree (1954), Rajkhowa (1961) etc. J.D. Hooker's "Flora of British India" and the first regional flora, "Flora of Assam" by Kanjilal and his colleagues had focused the floristic composition of this region. Some of the floristic studies of Assam are the outcome of Ph.D. works viz. "Angiosperms of Kamrup District" (Barua, 1992), "Systemic studies on the "Dicotyledonous plants of Lakhimpur District" (Singh 1993), "Herbaceous plants of Karbi- Anglong District" (Sarkar, 1993), *etc.* In the recent periods notable contributions were made by Chowdhury (1993, 1998, 2005), Nath (2014), Bhattacharjee *etal.* (2014) etc.

STUDY AREA:

Sualkuchi is a planned village situated on the north bank of the river Brahmaputra, about 35 km from Guwahati of Kamrup District, Assam. There are large numbers of cottage handloom industries for which it is also known as the "Manchester of Assam". Sualkuchi is located at 6.17°N latitude and 91.57°E longitude and 33 m altitude. The greater Sualkuchi covers a total area of 9.37 square kilometres. On the east side of Sualkuchi lies Lankas, Kaibartapara and Ananta hill; on the west side lies Bagheswari and Gobinda hill and on the north side Gondhamadan Prbatmala and the great Brahmaputra covers the south side of Sualkuchi area.

The hilly areas and Brahmaputra river bank areas have a rich plant diversity including many medicinal plants. The flora of this area is not explored earlier therefore there is an urgent need for the systematic enumeration, authentic identification and documentation of the flora of the area. Present paper deals with the angiospermic floristic diversity of the Sualkuchi area in Kamrup district of Assam.

MATERIALS AND METHODS:

The present investigation is the result of extensive field survey in Sualkuchi and its surrounding areas covering the different vegetation types (during 2013 – 2014) in all the seasons. For study of plant diversity depending upon the types of vegetation of the whole area divided roughly into – i) Hilly areas which includes Bagheswari, Bhringeswer, Gobinda, Fulbari hills ii) the bank of Brahmaputra river and iii) wet lands – includes the wet lands of SBMS College wetland, road side wet lands up to Bansar areas iv) Grass lands – include road-side areas, bank of Brahmaputra river, SBMS Col-

lege campus etc. Each area was randomly surveyed for the floristic elements covering all strata of the vegetation.

The plants were collected mainly in their flowering and fruiting stages and preserved as dried herbarium specimen using standard herbarium techniques (Jain and Rao, 1977). Identifications were done following *Flora of Assam* (Kanjilal etal., 1934 – 1940; Bor, 1940), *Flora of British India,* (Hooker, 1872-1897) and comparing the herbaria of Department of Botany Gauhati University. For the up to date nomenclature www.theplantlist.org and Plant Diversity of Assam (Barua and Ahmed, 2014) has been consulted.

RESULT AND DISCUSSION:

Results in the following table indicate the floristic analysis of Sualkuchi area. A total of 313 species of plants belonging to 94 families and 236 genera of angiospermic plants have been recorded from the study area. Out of which 255 species are dicot. and 58 are moncot plants. Six most dominanting families were Asteraceae, Caesalpiniaceae, Poaceae, Papilonaceae, Cucurbitaceae, Euphorbiaceae. Out of the total plant species 76 are trees, 59 are shrubs, 141 species are herbs and 27 species are climbers.

The beauty of the river bank area of Sualkuchi is enriched with the glooms of many trees like *Cassia fistula, Bombux ceiba, Samanea saman, Bauhinia purpurea, Caesalpinia pulcherrima, Delonix regia, Butea monosperma, Erythrina indica* etc.

Other dominating plants of river bank areas are *Calotropis gigantea, Ricinus communis, Laportea crenulata, different species of Ficus, Cassia ., Solanum* etc.

The wet lands of Sualkuchi are also rich with different types of aquatic vegetations like *Hydrilla verticillata, Enhydra fluctuans Echhornia crassipes, Monocharia hastate, Nymphaea nouchali, N. rubra etc,*

Notable medicinal plants blooms in these areas are *Dillenia indica*, *Phyllanthus ambelica, Terminalia arjuna, T. chebula, Averrhoa carambola, Aegle mormelos, Mimusops elengi, Azadirachta indica, Cassia fistula,Vitex negundo, Sida rhombifolia, Urena lobata, Cassia alata, Costus specious, Clerodendrum colebrookianum, Lawsonia inermis, Paederia foeitida, Asparagus recemosus, Piper longum, Oxalis corniculata, Mimosa pudica, Cassia tora, Mucuna pruriens, Cissus quadrangularis, Enhydra fluctuans, Tabernaemontana divericata, Datura stramonium, Ocimum sanctum, Euphorbia hirta, Centela asiatica, Hourttuyania cordata, Polygonum microcephalum, Chenopodium album, Andrographis paniculata, Bacopa monnieri, Solanum ferox, Nicotiana tobacum, Calotropis gigantea, Bryophyllum pinntum, Cynodon dactylon etc.*

Table: Floristic analysis of Sualkuchi Area of Kamrup, District Assam.

S. No.	Family	Scientific Name	Local Name	Type
1	Dilleniaceae	*Dillenia indica* L.	Ou tenga	Tree
2	Magnoliaceae	*Michelia champaca* L.	Titasapa	Tree
3	Annonaceae	*Annona reticulate* L.	Mewa	Tree
4	-do-	*A. squamosa* L.	Ata-phal	Tree
5	-do-	*Polyalthia longifolia* (Sonn.) Thw.	Debadaru	Tree
6	Menispermaceae	*Tinospora cordifolia* (Willd) Miers	Sagunilata	Climber
7	Nymphaeaceae	*Euryale ferox* Sailisb.	Makhana	Aquatic herb
8	-do-	*Nymphaea nouchali* Burm.f.	Baga-bhet	Aquatic herb
9	-do-	*N. rubra* Roxb. ex. Andrews	Ranga-bhet	Aquatic herb
10	Nelumbonaceae	*Nelumbo nucifera* Gaertn	Padum	Aquatic herb
11	Papaveraceae	*Argemone maxicana* L.	Sialkata	Herb
12	Brassicaceae	*Brassica campestris* L.	Sariah	Herb
13	-do-	*B. Juncea* (L.) Czern.	Lai-sak	Herb
14	-do-	*B. nigra* (L.) Koch	Kala sariah	Herb
15	-do-	*B. oleracea* L. var. *botrytis* L.	Phul-kabi	Herb
16	-do-	*B. oleracea* L. var. *capitata* L.	Bandha-kabi	Climber
17	-do-	*B. oleracea* L. var. gongylodes L.	Ol-kabi	Herb
18	-do-	*B.* rapa L.	Chalgom	Herb
19	-do-	*Nasturtium indicum* (L.) DC.	Ban-sariah	Herb
20	Capparaceae	*Stixis scandens* Lour	Madhabi-lata	Climber
21	Cleomaceae	*Cleome burmanni* Wight & Arn.	Bhutmala	Herb
22	-do-	*C. gynandra* L.	Bhutmala	Herb
23	-do-	*C. viscosa* L.	Bhutmala	Herb
24	Flacourtiaceae	*Flacourtia jangomas* (Lour) Raeusch	Paniol	Tree
25	Portulacaceae	*Protulaca grandiflora* Hook	Na-baji-phul	Herb
26	-do-	*P. oleracea* L.	Malbhog-sak	Herb
27	Tamaricaceae	*Tamarix dioica* Roxb.	Jhau	Shrub
28	Dipterocarpaceae	*Shorea robusta* Gaertn.	Sal	Timber-tree
30	Malvaceae	*Abelmoschus esculantus* (L.) Moench	Vendi	Under-shrub

31	-do-	*Abutilon indicum* L. Sweet	Japa	Under-shrub
32	-do-	*Gossypium barbedense* L.	Kapah	Shrub
33	-do-	*Hibiscus rosa-sinensis* L.	Rkta-joba	Shrub
34	-do-	*Sida cordifolia* L.	Son-barial	Herb
35	-do-	*S. rhombifolia* L.	Barial	Herb
36	-do-	*Urena lobata* L.	Sonbarial	Under-shrub
37	Bombacaceae	*Bombux ceiba* L.	Simalu	Tree
38	Sterculiaceae	*Sterculea villosa* Roxb.	Odal	Tree
39	Tilliaceae	*Corchorus capsularis* L.	Marapat	Shrub
40	-do-	*Triumfetta rhomboidea* Jacq.	Ban-agara	Shrub
41	Elaeocarpaceae	*Elaeocarpus floribundus* Blume	Jalphai	Tree
42	Oxalidaceae	*Oxalis corniculata* L.	Tengesi	Herb
43	-do-	*O. debilis* var. *Corymbosa* (DC.) Lour	Bor-tengeshi	Herb
44	Averrhoaceae	*Averrhoa carambola* L.	Kardoi	Tree
45	Rutaceae	*Aegle mormelos* (L.) Correa	Bel	Tree
46	-do-	*Citrus aurantifolia* (Cristem) Swing	Gol-nemu	Shrub
47	-do-	*C. maxima* (Burn.) Osbeck	Rabab-tenga	Tree
48	-do-	*C. limon* (L.) Burn.f.	Nemu	Shrub
49	-do-	*Murraya Koenigii* (L.) Spreng	Narasingh	Tree
50	-do-	*M. paniculata* (L.) Jack	Kamini	Shrub
51	Maliaceae	*Azadirachta indica* A. Juss.	Maha-neem	Tree
52	-do-	*Malia azedarach* L.	Ghora-neem	Tree
53	-do-	*Toona ciliate* M. Roem	Poma	Tree
54	Rhamnaceae	*Ziziphus mauritiana* Lam.	Bagari	Tree
55	Vitaceae	*Cissus quadrangularis* L.	Harjora-lata	Climber
56	Sapindaceae	*Litchi Chinensis* Sonn.	Lesu	Tree
57	Anacardiaceae	*Mangifera indica* L.	Aam	Tree
58	-do-	*Spondias pinnata* (L.f.) Kurz.	Amara	Tree
59	Moringaceae	*Moringa oleifera* Lam.	Sajina	Tree
60	Mimosaceae	*Acacia auriculiformis* Cunn ex Benth.	Acacia	Tree
61	-do-	*A. farnesiana* (L.) Willd.	Tarua-kadam	Shrub

62	-do-	*Albizzia procera* (Roxb.) Benth	Karoi	Tree
63	-do-	*Mimosa himalayana* Gamble	Lajuki-lata	Herb
64	-do-	*M. pudica* L.	Lajuki-ban	Herb
65	-do-	*Samanea saman* (Jacq.) Merr.	Siris	Tree
66	Caesalpiniaceae	*Bauhinia racemosa* Lam.	Kanchan	Tree
67	-do-	*B. purpurea* L.	Ranga-kanchan	Tree
68	-do-	*B. variegata* L.	Baga-kanchan	Tree
69	-do-	*Caesalpinia pulcherrima* (L.) Sw.	Radhasura	Tree
70	-do-	*Cassia alata* L.	Kharapat	Shrub
71	-do-	*C. fistula* L.	Sonaru	Tree
72	-do-	*C. hirsuta*L.	Madelua	Shrub
73	-do-	*C. occidentalis* L.	Madelua	Shrub
74	-do-	*C. siamea* L.		Tree
75	-do-	*C. sophera* L.	Madelua	Shrub
76	-do-	*C. tora* L.	Madelua	Herb
77	-do-	*Delonix regia* (Hook.) Raf.	Krishnasura	Tree
78	-do-	*Saraca asoca* (Roxb.) Willd.	Asok	Tree
79	-do-	*Tamarindus indica* L.	Tateli	Tree
80	Papilonaceae	*Butea monosperma* (Lam.) Taub.	Polash	Tree
81	-do-	*Cicer arietinum* L.	Boot	Herb
82	-do-	*Clitoria ternatea* L.	Aparajita	Climber
83	-do-	*Cajanus cajan* (L.) Huth.	Arahar	Shrub
84	-do-	*Crotalaria juncea* L.	Junjunia-ban	Under-shrub
85	-do-	*C. pallida* Aiton.	Ghantakarna	Herb
86	-do-	*Dalbergia sissoo* DC.	Sisu	Tree
87	-do-	*Derris indica* (Lam.) Bennet	Karas	Tree
88	-do-	*Erythrina stricta* Roxb.	Modar	Tree
89	-do-	*Flemingia strobilifera* (L.) Br.	Makhiyoti	Shrub
90	-do-	*Mucuna pruriens* (L.) DC	Bandarkekoa	Climber
91	-do-	*Tephrosia candida* (Roxb.) D.C.	Teli-kadam	Shrub
92	-do-	*T. purpurea* (L.) Pers.	Ban-nil	Herb
93	Rosaceae	*Rosa alba* L.	Baga-golap	Shrub

94	-do-	*R. indica* L.	Golap-phul	Shrub
95	-do-	*R. multiflora* Thunb.	Lata-golap	Shrub
96	Crassulaceae	*Bryophyllum pinntum*(Lam.) Oken.	Pategaja	Herb
97	Combretaceae	*Quisqualis indica* L.	Madhabi-lata	Climber
99	-do-	*Terminalia arjuna* (DC) W.&A.	Arjuna	Tree
100	-do-	*T. bellirica* (Gaertn) Roxb.	Bhomora	Tree
101	-do-	*T. chebula* Retz.	Silikha	Tree
102	Myrtaceae	*Callistemon citrinus* (Curtis) Skeels	Bottle-brash	Tree
103	-do-	*Eucalyptus maculata* Hook.	Eucalyptus	Tree
104	-do-	*Psidium guajava* L. Tree	Mdhuri-aam	Tree
105	-do-	*Syzygium cumini* (L.)Skeels	Kala-jamu	Tree
106	Melastomaceae	*Melastoma malabathricum* L.	Phutuka	Shrub
107	-do-	*Osbeckia rostrata* D. Don.	Phuutuka	Shrub
108	Lythraceae	*Lagerstroemia purviflora* Roxb.	*Sidha*	Tree
109	-do-	*L. speciosa* (L.) Pers.	Ajar	Tree
110	-do-	*Lawsonia inermis* L.	Jetuka	Shrub
111	Crypteroniaceae	*Dunbanga grandiflora* Roxb.) Walp	Khokan	Tree
112	Punicaceae	*Punica granatum* L.	Dalim	Tree
113	Onagraceae	*Jussiaea repens* L.	Pani-khutura	Herb
114	-do-	*Ludwigia adscendens* (L.) Hara	Saru-halas	Herb
115	Trapaceae	*Trapa natans* L.	Pani-singari	Aquatic-herb
116	Caricaceae	*Carica papya* L.	Amita	Tree
117	Cucurbitaceae	*Benincasa hispida* (Thumb.) Cogn.	Chal-komora	Climber
118	-do-	*Citrullus colocynthis* (L.) Schrad.	Kuwa-vaturi	Herb
119	-do-	*Momordica charantia* L.	Tita-kerela	Climber
120	-do-	*M. dioica* Roxb. ex. Willd.	Bhat-kerela	Climber
121	-do-	*Cucumis melo* L.	Bangi	Climber
122	-do-	*C. sativus* L.	Tiyah	Climber
123	-do-	*Cucurbita maxima* Duch	Mitha-lao	Climber
124	-do-	*C. pepo* L.	Komora	Climber
125	-do-	*Lagenaria siceraria* (Monila) Standl.	Pani-lao	Climber
126	-do-	*Luffa acutangula* (L.) Roxb.	Jika	Climber
127	-do-	*L. cylindrica* (L.) Roem.	Bhol	Climber

128	-do-	*Trichosanthes cucumerina* L.	Nileji	Climber
129	Cactaceae	*Opuntia dillenii* (Ker Gawl.) Haw.	Sagar-phena	Shrub
130	-do-	*Cereus repandus* (L.) Mill.	Siju	Herb
131	Apiaceae	*Centela asiatica* (L.) Urb.	Manimuni	Herb
132	-do-	*Coriandrum sativum* L.	Dhania	Herb
133	-do-	*Daucas carota* L.	Gajar	Herb
134	-do-	*Eryngium foetidum* L.	Man-dhania	Herb
135	-do-	*Hydrocotyle sibthorpioides* Lam.	S a r u - manimuni	Herb
136	Rubiaceae	*Ixora coccinea* L.	Rangan	Shrub
137	-do-	*Paederia foeitida* L.	Bhebeli-lata	Climber
138	-do-	*Gardenia florida* L.	Tagar	Shrub
139	-do-	*Oldenlandia corymbosa* L.	Sarpajeva-ban	Herb
140	Asteraceae	*Ageratum conyzoides* L.	Ganheli-ban	Herb
141	-do-	*Chromolaena odorata* (L.) Voigt	Jarmani ban	Herb
142	-do-	*Chrysanthemum coronarium* L.	Indramalati	Herb
143	-do-	*Eclipta prostrate* (L,) L.	Kehraj	Herb
144	-do-	*Elephantopus scaber* L.	Hati-khoj	Herb
145	-do-	*Emilia soncifolia* (L.) DC.	Kurkuchi	Herb
146	-do-	*Enhydra fluctuans* DC.	Helachi	Herb
147	-do-	*Helianthus annuus* L.	Beliphul	Herb
148	-do-	*Mickania micrantha* Kunth.	Jarmani-lata	Climber
149	-do-	*Parthenium hysterophorus* L.	Parthenium	Herb
150	-do-	*Spilanthus paniculata* DC	Mahavingaraj	Herb
151	-do-	*Tridax procumbens* L. (L.)		Herb
152	-do-	*Vernonia cinerea* (L.) Lees.		Herb
153	-do-	*Xanthium strumarium* L.	Agora	Herb
154	-do-	*Wdellia calendulacea* Lees.	Vingaraj	Herb
155	Sapotaceae	*Mimusops elengi* L.	Bakul	Tree
156	Oleaceae	*Jasminum laurifolium* Roxb.	Gutimalati	Shrub
157	-do-	*Nyctanthus arbour-tristis* L.	Sewali	Tree
158	Apocynaceae	*Allamanda cathartica* L.	Ghanta-phul	Shrub
159	-do-	*Alstonia scholaris* (L.) R. Br.	Chatiyana	Tree

160	-do-	*Cascabela thevetia* (L.) Lippold	Halodhia-korobi	Shrub
161	-do-	*Catharanthus roseus* (L.) G. Don	Nayantora	Herb
162	-do-	*Holarrhena pubescens* Wall.	Dudh-kari	Tree
163	-do-	*Nerium oleander* L.	Rakta-karabi	Shrub
165	do-	*Plumeria alba* L.	Boga-gulanch	Shrub-tree
166	-do-	*P. rubra* L.	Ranga-gulanch	Shrub-tree
167	-do-	*Tabernaemontana divericata* (L) R.Br.	Kathanda	Shrub
168	-do-	*Thevetia neriifolia* Juss.	Baga-karabi	Shrub-tree
169	Asclepiadaceae	*Calotropis gigantea* (L.) Dryand	Akon	Shrub
170	-do-	*Hoya parasitica* Wall.	Lahom-pat	Shrub
171	Convolvulaceae	*Evolvulas nummularius* (L.) L.	Volupa	Herb
172	-do-	*Ipomea aquatic* Forssk.	Kalmou	Herb
173	-do-	*I. batatas* (L.) Lam.	Mitha-alu	Climber
174	-do-	*I. carnea* Jacq.	Pani-votora	Shrub
175	-do-	*Merremia vitifolia* (Burm. f.) Hallier f.	Digi-lewa	Climber
176	Cuscutaceae	*Cuscuta reflexa* Roxb.	Raghumala	Climber
177	Solanaceae	*Datura metal* L.	Dhatura	Herb
178	-do-	*D. stramonium* L.	Dhatura	Herb
179	-do-	*Lycopersicon esculantum* Mill	Bilahi	Shurb
180	-do-	*Nicotiana tobacum* L.	Dhopat	Herb
181	-do-	*Physalis minima* L.	Kapal-phota	Herb
182	-do-	*Solanum ferox* L.	Bhot-bengena	Herb
183	-do-	*S. melongena* L.	Bengena	Under-shrub
184	-do-	*S. nigrum* L.	Titbhakuri	Herb
185	-do-	*S. torvum* Swartz.	Hati-bhekuri	Under-shrub
186	-do-	*S. tuberosum* L.	Alu	Herb
187	Scrophulariaceae	*Bacopa monnieri* (L.) Wetts.	Brahmi-sak	Herb
188	-do-	*Linderni crustacea* (L.) F. Muel	Khar	Herb
189	-do-	*Scoparia dulcis* L.	Bon-dhonia	Herb
190	Pedaliaceae	*Sesamum indicum* L.	Til	Shrub

191	Acanthaceae	*Andrographis paniculata* Nees.	Kalmegh	Herb
192	-do-	*Dicliptera roxburghiana* Ness		Herb
193	-do-	*Justicia adhtoda* L.	Baga-bahak	Herb
194	-do-	*J. japonica* Thunb.		Herb
195	Verbenaceae	*Callicarpa arborea* Roxb.	Bon-mola	Tree
196	-do-	*Clerodendrum colebrookianum* Walp.	Nephaphu	Shrub
197	-do-	*C. viscosum* Vent.	Vetetita	Shrub
198	-do-	*Gmelina arborea* Roxb.	Gamari	Tree
199	-do-	*Holmskioldia sanguinea* Retz.	Chatra-phul	Shrub
200	-do-	*Lantana camara* L.	Banabahar	Shrub
201	-do-	*Tectona grandis* L. f.	Segun	Tree
202	-do-	*Vitex altissima* L.f.	Ahui	Tree
203	-do-	*Vitex negundo* L.	Pasatia	Shrub
204	Lamiaceae	*Anisomales ovalifolia* (L.) O. Ktze		Herb
205	-do-	*Leucas plukentii* (Roth) Spreng	Doron	Herb
206	-do-	*Leonurus sibricus* L.	Ranga doron	Herb
207	-do-	*Ocimum sanctum* L.	Kala-tulasi	Herb
208	-do-	*O. basilicum* L.	Ram-tulasi	Herb
209	-do-	*O. americanum* L.	Ban-tulasi	Herb
210	-do-	*Hyptis suaveolens* Poit.	Tokma-tita	Herb
211	-do-	*Pogostemon benhalensis* O.Kuntze.	Suklati	Herb
212	Nyctaginaceae	*Bougainvillea spactabilis* Wiid.	Kagaj phul	Shrub
213	-do-	*Mirabilis jalapa* L.	Godhuligopal	Herb
214	Amaranthaceae	*Amaranthus spinosus* L.	Kata-khutura	Herb
215	-do-	*A. viridis* L.	Khutura	Herb
216	-do-	*A. polygonoides* L.	Khutura	Herb
217	-do-	*Achyranthes porphyristachya* Wall. ex Moq.	Obhota-kata	Herb
218	-do-	*Alternanthera sessilis* R. Br.	Mati-kaduri	Herb
219	-do-	*Cyathula prostrata* (L.) Bl.	Bonkhoth	Herb
220	Chenopodiaceae	*Chenopodium album* L.	Bhotua-sak	Herb
221	Basellaceae	*Basella alba* L.	Pui-sak	Climber

222	Polygonaceae	*Polygonum barbatum* L	Bihlayani	Herb
223	-do-	*P. hydropiper* L.	Bihlayani	Herb
224	-do-	*P. microcephalum* D. Don.	Madhu-saleng	Herb
225	-do-	*Rumex nepalensis* Spreng.	Tor-boura	Herb
226	Piperaceae	*Peperomia pellucida* (L.) Kunth	Ponounua	Herb
227	-do-	*Piper longum* L.	Pipali	Climber
228	-do-	*P. nigrum* L.	Jaluk	Climber
229	Saururaceae	*Hourttuynia cordata* Thunb.	Mosundori	Herb
230	Lauraceae	*Cinnamomum tamala* Nees & Eberm.	Tejpat	Tree
231	-do-	*Litsea salicifolia* Hook.f.	Dighloti	Shrub
232	Thymeleaceae	*Aquilaria malaccensis* Lam.	Agaru	Tree
233	Santalaceae	*Santalum album* L.	Chandan	Tree
234	Euphorbiaceae	*Acalypha indica* L.	Mukuta-manjuri	Herb
235	-do-	*Baccaurea ramiflora* Lour.	Lateku	Tree
236	-do-	*Codiaeum variegatum* (L.) Bl.	Pata-bahar	Shrub
237	-do-	*Croton bonplandianum* Baill.	Ban-tulasi	Herb
238	-do-	*Euphorbia neriifolia* L.	Siju	Shrub
239	-do-	*E. pulcherrima* Willd.	Lal-pata	Shrub
240	-do-	*E. hirta* L.	Gakhirati-bon	Herb
241	-do-	*Jatropha curcas* L.	Bhotora	Shrub
242	-do-	*J. gossypiifolia* L.	Bhot-era	Shrub
243	-do-	*Phyllanthus emblica* L.	Amlokhi	Tree
244	-do-	*Ricinus communis* Linn.	Era	Shrub
245	-do-	*Trewia nodiflora* L.	Bhelkal	Tree
246	Urticaceae	*Laportea crenulata* Gaud.	Chorot	Shrub
247	Moraceae	*Artocarpus heterophyllus* Lam.	Kothal	Tree
248	-do-	*Ficus benghalensis* L.	Bat-goch	Tree
249	-do-	*F. religiosa* L.	Ahat	Tree
250	-do-	*F. racemosa* L.	Dimoru	Tree
251	-do-	*F. benjamina* L.	Jari-gas	Tree
252	-do-	*F. elastic* Roxb.	Athabar	Tree

253	-do-	*F. drupacea* Thunb.	Dhop-bar	Tree
254	-do-	*Streblus asper* Lour	Sarua	Tree
255	Cannabaceae	*Cannabis sativa* L.	Bhang-gas	Shrub
256	Hydrocharitaceae	*Hydrilla verticillata* (L.f.) Royle	Hydrila	Aquatic-herb
257	Orchidaceae	*Aerides odorata* Lour	Baga-kapou	Epiphytic herb
258		*Dendrobium aphyllum* (Roxb.)	Kopou-phul	Epiphytic herb
259	-do-	*Rhynchostylis retusa* (L.) Bl.	Kopou-phul	Epiphytic herb
260	Zingiberaceae	*Curcuma amada* Roxb.	Aam-ada	Herb
261	-do-	*C. aromatic*a Salisb	Keturi	Herb
262	Musaceae	*Musa balbisiana* Colla	Bhim-kol	Gigantic-herb
263	-do-	*M. champa* Hort.	Senisampa-kol	Gigantic-herb
264	-do-	*M. chinensis* Sweet.	Jahaji-kol	Gigantic-herb
265	-do-	*M. pardisiaka* L.	Kas-kal	Gigantic-herb
266	-do-	*M. sapientum* L.	Monohor kal	Gigantic-herb
267	Costaceae	*Costus specious* (Koen.) Smith.	Jam lakhuti	Shrub
268	Cannaceae	*Canna indica* L.	Parijat	Herb
269	Bromeliaceae	*Ananas comosus* (L.) Merr.	Anaras	Herb
270	Amaryllidaceae	*Crinum asiaticum* L.	Ban-naharu	Herb
271	-do-	*Polianthes tuberosa*L.	Rajani-gandha	Herb
272	Agavaceae	*Agave cantala* (Haw.) Roxb.	Dager-plant	Herb
273	Dioscoreaceae	*Dioscorea alata* L.	Kath-alu	Climber
274	-do-	*D. bulbifera* L.	Goch-alu	Climber
275	Liliaceae	*Aloe vera* (L.) Burm.f.	Chal-kuori	Herb
276	-do-	*Asparagus recemosus* Willd	Satamul	Herb
277	Alliaceae	*Allium cepa* L.	Piyaj	Herb
278	-do-	*A. sativum* L.	Naharu	Herb
279	Pontederiaceae	*Echhornia crassipes* (Mart.) Solms	Mateka	Aquatic-herb
280	-do-	*Monocharia hastate* (L.) Solms.	Bih-mateka	Aquatic-herb
281	Commelinaceae	*Commelina benghalensis* L.	Kona-shimolu	Herb

282	-do-	*Floscopa scandens* Lour.	Kona-shimolu	Herb
283	Arecaceae	*Areca catechu* L.	Tamol-goch	Palm-tree
284	-do-	*Borassus fabellifer* L.	Tal-goch	Palm-tree
285	-do-	*Cocos nucifera* L.	Narikal-goch	Palm-tree
286	-do-	*Phoenix sylvstris* Roxb.	Khejur	Palm-tree
287	-do-	*Livistona jenkinsiana* Griff	Tokou	Palm-tree
288	Pandanaceae	*Pandanus fascicularis* Lam.	Kateki-phul	Shrub
289	Araceae	*Acorus calamus* L.	Boch	Herb
290	-do-	*Alocasia cucullata* Schott.	Mukhi-kachu	Herb
291	-do-	*Alocasia indica* (Lour) Koch.	Man-kochu	Herb
292	-do-	*Amorphophallus paeoniifolius* (Den)Ni.	Olkachu	Herb
293		*Homalomena aromatic* (Spreng.) Scott.	Gan-kachu	Herb
294	-do-	*Pistia stratioetes* L.	Barpuni	Aquatic-herb
295	-do-	*Typhonium trilobatum* (L.) Schott.	Sam-kochu	Herb
296	Lamnaceae	*Lamna perpusila* Torrey	Soru-puni	Aquatic-herb
297	Alismaceae	*Segitaria segittifolia* L.	Pani-kochu	Aquatic-herb
298	Cyperaceae	*Cyperus pilosus* Valh.	Harkota-bon	Herb
299	-do-	*C. rotundus L.*	Kenga-bon	Herb
300	-do-	*C. brevifolius* L.	Tupi-bon	Herb
301	Poaceae	*Arundo donax* L.	Nol	Herb
302	-do-	*Bambusa arundinacea* (Rez.) Willd	Kota-banh	Bamboo
303	-do-	*B. balcooa* Roxb.	Bhaluka-banh	Bamboo
304	-do-	*B. pallid* Munro	Bijili-banh	Bamboo
305	-do-	*B. tulda* Roxb.	Jati-banh	Bamboo
306	-do-	*Cymbopogon nardus* (L.) Rendle	Chitranala	Herb
307	-do-	*Cynodon dactylon* (L.) Pers.	Dubori-bon	Herb
308	-do-	*Crysopogon aciculatus* Tinn	Banguti	Herb
309	-do-	*Hygroryza aristata* Retz.Ness	Dol-ghah	Herb
310	-do-	*Imperata cylindrical* (L.) P. Beauv.	UIlu-bon	Herb
311	-do-	*Oryza sativa* L.	Dhan	Herb
312	-do-	*Phragmites harka* Trin. ex. stend.	Khagari	Herb
313	-do-	*Saccharum officinarum* L.	Kuhiar	Herb

CONCLUTION:

Due to over exploitation and lack of conservation, a number of valuable plants have become vulnerable. A major part of the wet lands of the area are at present converted to residential areas by soil filling which totally destroyed the major aquatic vegetations. To protect the floral diversity of these areas, it is necessary to increase the consciousness of the local people to conserve the existing vegetations. Also it is needed for cultivation, processing and conservation of rare and threatened plants including medicinal plants, through appropriate methods to meet the developmental task.

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