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Van Sangyan

Note to Authors:

We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

by e-mail to vansangyan_tfri@icfre.org

or, through post to The Editor, Van Sangyan,
Tropical Forest Research Institute,
PO-RFRC, Mandla Road,
Jabalpur (M.P.) - 482021.

The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number.

TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve
Photo credit: Dr. N. Roychoudhury and Dr. Rajesh Kumar Mishra, TFRI, Jabalpur (M.P.)

From the Editor's desk

In the tropics, nutrients essential to crop plant health are primarily in organic matter, not bound up in the soil. Organic matter needs to cycle through the soil for nutrients to get to plants. Cutting weeds back and mulching plantings with them is a common practice with tropical farmers, and increases crop plant health. It is best to cut the weeds before they seed to keep the seeds from sprouting right next to the crop. Weeds also can be soaked in water in a covered container for about a week then fed to plants in a (smelly!) nutrient-rich liquid fertilizer tea. Weeds are useful, particularly as food for soil life, people, animals, and plants, It can use as a resource. But, what about when it looks like the weeds are eating the crop plants, and not the other way around? In the natural process of succession, weeds establish where they find a place, usually in open or partially open conditions, especially on bare soil. They modify the environment, eventually making the area inhospitable (too shady, etc.) to more of their kind. Other plants come in who thrive in the modified conditions, and the process of succession continues until the ecosystem is more or less stable, usually culminating in a closed-canopy forest. Weeds are involved in the primary stages of natural succession. They are medicine for the soil, repairing it and revitalizing life.

Effectively utilizing forest residues can offset the costs of forest restoration and fire hazard treatments while facilitating follow-up forest management activities. Further, the use of these bio-based forest products can improve air quality, reduce greenhouse gas emissions, sequester carbon, amend soil, and create employment in rural forestry-dependent communities, while reducing the nation's reliance on imported fossil fuels. New technologies that are capable of converting previously wasted or underutilized forest residues into high quality and sustainable bioenergy and useful bio-based products are emerging. By using biomass conversion technologies, it can add value to residues in the field while significantly reducing transportation costs.

This issue of Van Sangyan contains an article on Weeds in tropics and Value addition technology for forest residues. There are also useful articles on Scope and potential of agroforestry in Chhattisgarh, Analysis of richness, diversity and eveness (she-analysis) of insect faunal population in teak-sal ecotone of Pachmari biosphere reserve, Pheromonal control of insects (in Marathi), The wild leafy vegetables of Telangana state and their importance in modern food security systems, Nanotechnology in forestry and wood science, Biotechnology for sustainable agriculture, Moths of Achanakmar-Amarkantak biosphere reserve (in Hindi) and biodiversity of Meconopsis aculeate and Passer rutilans

I hope that readers would find all information in this issue relevant and valuable. Van Sangyan welcomes articles, views and queries on various issues in the field of forest science.

Looking forward to meet you all through forthcoming issues.

Dr. N. Roychoudhary
Scientist G & Chief Editor

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Weeds in tropics: Problems and prospects

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Abstract
Weeds have been reckoned as a major threat globally and act as dampener for crop production despite the farmers putting enormous effort in their removal to get better yield. Despite decades of research and development and advances in management practices aimed at their management, weeds remain as a constant threat to productivity and sustainability of soil and environment. The composition and competition by weed is dynamic and is dependent on soil, climate, crop and management factors. The biology and ecology of weeds is not the same for all regions and hence, weed management strategies will have to different for each agro-ecological condition.

Introduction
The agriculture and allied sectors continue to be the largest source of livelihood security for millions of households across the world, especially in the developing countries. The scientific and technological inputs have been major drivers of growth and development in agriculture and allied sectors that have enabled us to achieve self-reliant food security with a reasonable degree of resilience even in times of natural calamities. Despite decades of research and development and advances in management practices aimed at their management, weeds remain as a constant threat to productivity and sustainability of soil and environment (Yaduraju et al., 2015). More than one-third of the total losses are caused by weeds alone which often get unnoticed due to their hidden effects on plant growth. Besides reducing crops yields, their infestation adversely affects produce quality, environment, biodiversity, soil health, animal health and aesthetic value of the area. Despite the develop weed managements in tropics such as use of chemical fertilizers, irrigation, short-statured, high-yielding varieties and hybrids, intensive tillage, monocropping systems devoid of legumes, and their adaptation by the stakeholders, farmers due to acute labour scarcity for manual weeding and the high cost practices has been increasing virtually. Due to dynamic nature of weeds, their adoption to high input and intensive cropping systems and management practices including herbisides, shifts in weed flora and several other reason. It is necessitates to continuous monitoring and refining management strategies for alleviating their adverse effects on productivity and environment.

Weed composition
Weed species associated with any ecosystem depends on the crop grown used management practices, environmental characteristics, biotic and abiotic factors. Major weed species in different situations are given as follows:
Agricultural fields: *Ageratum conyzoides, Alternanthera paronychioides, Cyperus rotundus, Cynodon dactylon, Dactyloctenium aegyptium, Eleusine indica, Echinochloa crussgalli, Emblica sonchifolia, Eragrostis unioloides, Mimosa pudica, Orobanche cernua,*

Pennisetum pedicellatum, *Phalaris minor*, *Phyllanthus niruri* and *Striga asiatica.*

Forestry fields: *Abelmoschus moschatus*, *Costus speciosus*, *Mikania micrantha*, *Lantana camara* and *Stachytarpheta jamaicensis.*

Horticulture fields: *Alternanthera philoxeroides*, *Chlorodendron viscosum*, *Chromolaena odorata*, *Mimosa diplotricha*, *Mitracarpus villosus* and *Parthenium hysterophorus*.

Non-cropped fields: Cuscuta reflexa, Parthenium

Aquatic fields: *Alternanthera philoxeroides* (alligator weed), *Eichhornia crassipes* (water hyacinth), *Hydrilla verticellata*, *Pistia stratiotes* (water lettuce), *Salvinia molesta* (water fern), *Typha aungatata* and *Water hyacinth.*

Weed Management

The manual removal of weeds is the predominant method of weed management practices in tropics. It is highly laborious, inefficient and often uneconomical. Weed competition during the early stages of crop growth and also competing for light, moisture, nutrients and space which will be ultimate adverse effect on growth of the major plant and yield. Ideal, weeding is done 3-4 weeks after the planting. There are several methods to control weed management such as non-chemical method, chemical method and biological method.

Non chemical method

Weeds cause serious yield losses if they are not controlled fully and at the right time. The degree of yield reduction depends on a number of factors such as weed flora, intensity, tillage and cultural practices, input use, soil and weather condition. The non chemical weed management in crops requires an integrated approach that utilizes preventive, cultural, mechanical, biological, ecological methods in a mutually supported manner into the crop production system. It is difficult to eradicate all the weeds, therefore, it is better to manage them to a certain stage of the crop, where they could cause minimum damage to the crop. Different methods of weed management have been used with different degree of success in different agro-ecological zones and productions system, which are weed prevention, physical weed management, tillage, mulching, solarisation, cultural weed management, crop rotation and cover crops, stale seed bed, intercropping, nutrient management, plant geometry and plant density, mycoherbicides, competitive crops and cultivars, water management, cropping system approach and site specific weed management.

Chemical methods

Management of weeds through the use of chemicals (herbicides) is slowly but steadily gaining popularity. Herbicides are used either before planting, immediately after planting or after the crop emergence. Herbicides, like any other pesticide is poisonous in nature and results in toxicity to the user and the environment, if used injudiciously. Due to application of herbicides, soil microbial activities have been decrease and to recover its original status will require 4-6 weeks of application (Reddy, 2015). It requires minimum labours but due to increasing availability of locally manufactured herbicides has become cost effective. Continuous use of herbicide results in weed flora shifted from minor to major weed. Some of the common active ingredients of herbicides and their use have given below (Vikas Kumar and Kunhamu, 2016).

Active Ingredient	Weeds Controlled	Where Used	Notes
Glyphosate: Nonselective, postemergent	Most annual weeds	As spot treatments on weeds or clumps of weeds	Will injure desired plants if spray gets on them.
Plant oils including clove, lemongrass. and eugenol: Nonselective, postemergent	Young broad leaves	In cracks and crevices or as spot treatments	Organically acceptable. Won't control older weeds or perennials. Best when temperatures are higher than 70°F.
Trifluralin: Selective, preemergent	Most annual weeds	Gardens and lawns	Water or cultivate soil after applying. Use after garden plants is established.
Benefin: Selective, preemergent	Most annual weeds	Lawns	Often used for crabgrass control.
Dithiopyr: Selective, preemergent	Crabgrass, annual bluegrass, oxalis, spurge, and others	Lawns	Will injure fine fescue and bentgrass.
Dicamba: Selective, postemergent	Broad leaves	Lawns	Controls clover and other broadleaf weeds in lawns.
Fluazifop: Selective, postemergent	Grasses including bermudagrass	In broadleaf groundcovers or landscape beds	Apply when grass weeds are actively growing.
2,4-D or 2,4-Dichloro-acetic acid: Selective, postemergent	Broad leaves	Lawns	Controls dandelion and other broadleaf weeds in lawns.

Biological Weed Control:

Biological control of weeds involves the use of living organisms (*i.e.* insects, pathogens, nematodes, parasitic plants and or other competitive plants) to keep population of a specific weed below the critical level. It includes the classical (inoculative), bioherbicides (inundative) approaches and herbivore management. The process involves collecting exotic natural enemies followed by importing, rearing, testing, and release from quarantine into target habitat for their establishment. On the other hand, the biological control approach makes use of the invasive plant's naturally occurring enemies, to help reduce the invasive plant's impact on agriculture and the environment. It simply aims to reunite weeds with their natural enemies and achieve sustainable weed control. These natural enemies of weeds are often referred to as biological control agents. It is critical that the biological control agents do not become pests themselves. Considerable host-specificity testing is

done prior to the release of biological control agents to ensure they will not pose a threat to non-target species such as native and agricultural plants. Not all weeds are suitable for biological control. Developing a biological control project requires a substantial investment, sometimes costing millions of dollars, from stakeholders. A biological control agent is generally only used when the cost of conventional control methods such as herbicides, mechanical control or fire is so great, both in dollar terms and impact on the environment, that there is little option than to pursue the biological control avenue.

The goal of biological control is not eradication, but the use of living agents to suppress vigor and spread of weeds. Such agents can be insects, bacteria, fungi, or grazing animals such as sheep, goats, cattle or horses. Grazing produces results similar to mowing, and bacteria and fungi are seldom available for noxious weed management. Biological control is most commonly thought of as 'insect biocontrol'. Biological weed control through insect/plant interactions is an important component of the County's weed management program. Insect agents, proven to be effective, are utilized in cases where eradication is impractical due to the vastness or inaccessibility of an infestation, and where other methods of management are not feasible. Insect agents typically require 3-5 years for establishment and can limit the spread and density of target weed species by feeding on leaves, stems, roots and/or seed heads. One must realize that eradication of a weed cannot be attained through insect biocontrol. The most effective scenario is a weed infestation reduced to a 'tolerable level', a level where the insect agents are significantly limiting distribution and abundance of the target weed species and the weed density is no longer considered detrimental to the desired plant community. Some biocontrol insects proven to be successful in Larimer County are: Bindweed mites - field bindweed, Flea beetles - leafy spurge, Mecinus janthinus - dalmatian toadflax, Larinus minutus and Cyphocleonus achates - diffuse knapweed.

Bioherbicides

Bioherbicides is another way of controlling weeds without environmental hazards posed by synthetic herbicides. Bioherbicides are made up of microorganisms (e.g. bacteria, viruses, fungi) and certain insects (*e.g.* parasitic wasps, painted lady butterfly) that can target very specific weeds. The microbes possess invasive genes that can attack the defense genes of the weeds, thereby killing it.

The better understanding of the genes of both microorganisms and plants has allowed scientists to isolate microbes (pathogens) whose genes match particular weeds and are effective in causing a fatal disease in those weeds. Bioherbicides deliver more of these pathogens to the fields. They are sent when the weeds are most susceptible to illness.

The genes of disease-causing pathogens are very specific. The microbe’s genes give it particular techniques to overcome the unique defenses of one type of plant. They instruct the microbe to attack only the one plant species it can successfully infect. The invasion genes of the pathogen have to match the defense genes of the plant. Then the microbe knows it can successfully begin its attack on this one particular type of plant. The matching gene requirement means that a pathogen is

harmless to all plants except the one weed identified by the microbe's genetic code.

This selective response makes bioherbicides very useful because they kill only certain weed plants that interfere with crop productivity without damaging the crop itself. Bioherbicides can target one weed and leave the rest of the environment unharmed.

The benefit of using bioherbicides is that it can survive in the environment long enough for the next growing season where there will be more weeds to infect. It is cheaper compared to synthetic pesticides thus could essentially reduce farming expenses if managed properly. It is not harmful to the environment compared to conventional herbicides and will not affect non-target organisms.

With the advances of genetic engineering, new generation bioherbicides are being developed that are more effective against weeds. Microorganisms are designed to effectively overcome the weed's defenses. Weeds have a waxy outer tissue coating the leaves that microorganisms have to penetrate in order to fully infect the weeds. Through biotechnology, these microorganisms will be able to produce the appropriate type and amount of enzymes to cut through the outer defenses. Streamlining of the microbe's plant host specificity will ensure that the weeds are taken out and not the crops. On the other hand, microbes can also be made to be effective against several host weeds and not only to one type of weed as this can be too expensive to produce for commercial use.

Advantages of bioherbicides:

- High degree of specificity of target weed.
- No effect on non target and beneficial plants or man.
- Absence of residue build-up in the environment.
- Effectiveness for managing herbicide resistant (HR) weed populations

Limitations of bioherbicides:

- Biological constraints
- Environment constraints
- Technical constraints and
- Commercial limitations

Integrated Weed Management

It don't meant to replace selective, safe and efficient herbicides but is a sound strategy to encourage judicious use of herbicides along with other safe, effective, economical and eco-friendly control measures. The use of clean crop seeds and seeders, and weed-free irrigation canals and bunds should be integrated for effective weed management. Weed control efficiency of applied herbicides and crop competitiveness against weeds can be improved by combining good agronomic practices, timeliness of operations, fertilizer and water management and retaining crop residues on the soil surface. Approaches such as stale seedbed practice, uniform and dense crop competitiveness with combination of pre and post emergence herbicides should be integrated to develop sustainable and effective weed management.

Opportunities for weed management:

- Weed utilization techniques are available for effective conversion of weed biomass into enriched compost, medicinal us, bioremediation and industrial application.
- Emphasis is being given to develop solar energy-aided microwave generating device for the control target weeds.

- Search of bioactive botanicals and microbial metabolites, which may act as lead molecules for herbicide development, is an essential component of weed management.
- Research on nano composite based controlled release formulation is essential for precision weed management.
- Research carried on biofertilizer based on weed control management.
- Herbicide tolerant crops will be introduced.
- The advances in molecular biology and biotechnology have enabled scientist to develop crop plant which resist the application of non selective herbicide.

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Briquetting - Value addition technology for forest residues

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Fossil fuels are very important energy sources in today's world, because there is a drastic increase in human populations, industrial growth and automobiles (Mythili and Venkatachalam, 2013). It has more drawbacks like non-renewable, high price and deplete in near future (Sumaran and Seshadri, 2010). It also causes numerous environmental changes such as air pollution, global warming, green gas emissionsand climate change (Franco and Diaz, 2009). So there is an unprecedented growing demand to meet energy supply by sustainable, eco-friendly and renewable energy for domestic and industrial demand. There is an urgent need to change fossil fuel to renewable energy (King, 2016). India is the one of the largest energy consumption in the world, which account for 6 % of the world energy demand with 474 Kg/yr per capita energy consumption (IEO, 2015). In India, 71 % of energy requirement are fulfilled by importing from other countries especially petroleum products (Kanna *et al.*, 2011). Biomass is the one of the major renewable energy in world, which is accounted for only 14 % (Sumaran and Seshadri, 2010; Mythili and Venkatachalam, 2013). They are more abundant in nature with free or almost free, indigenous and energy rich sources. About 46 % of the total energy consumption is met from various biomass residues viz.,agro residues forest residues, animal waste and firewood (Tripathi*et al.*, 1997; Bhardwaj, 2009;Gyeltshen, and Nidup, 2010). Forest residues were gradually increasing with forest plantations and wood based industries in near future (Bhardwaj, 2009; Rawat, 2009; Kanna *et al.*, 2011).

Forest residues

Forest residues are defined as a biomass by-product from forest land use system and includes invasive weeds from forest areas, fruit shell, nursery wastes, pruning and thinning waste from forest plantations, wastes from wood industries (Yumak*et al.*, 2010; Sinha, 2013).There is wide range of forest residues available are were branches, roots, barks, leaves and fruit shell, cutted waste from industries, saw dust from saw mills (Fig 1) (Gyeltshen, and Nidup, 2010; Grover and Mishra, 1996; Kanna *et al.*, 2011).

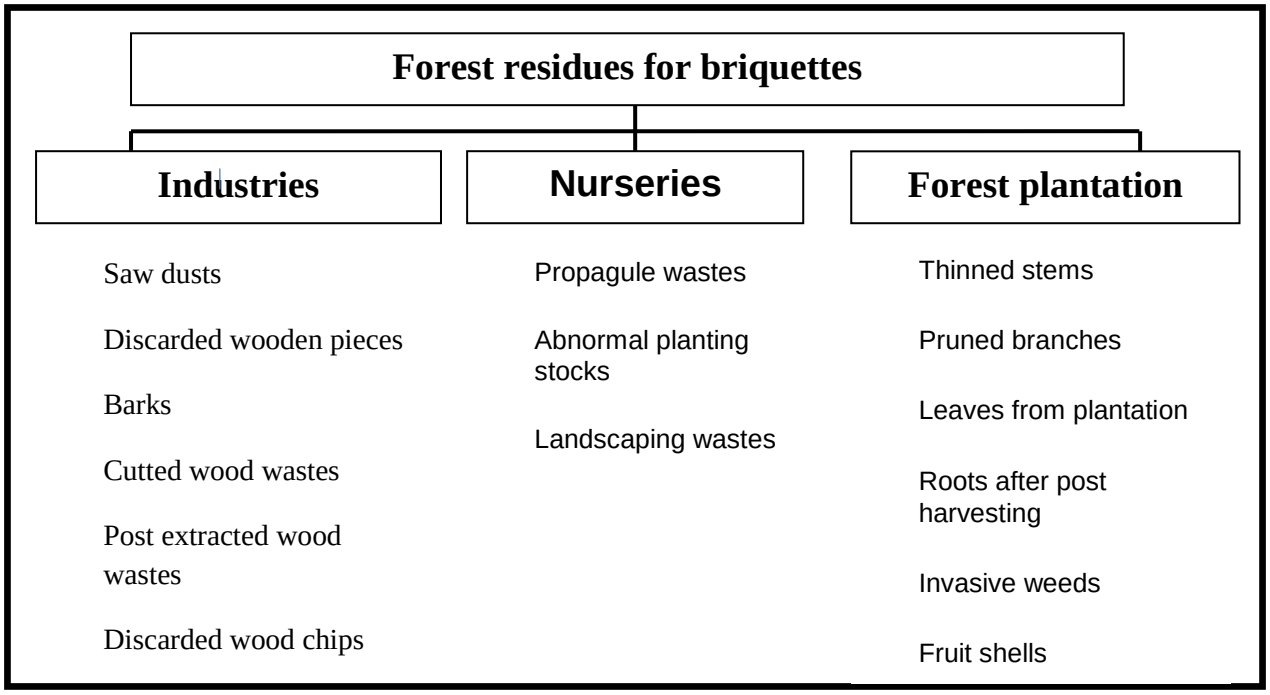
Utilization of forest residues will reduces the incidents of forest fire, alien species invasion, pest and disease from residues to plants and protection of environment (Rawat, 2009; Gyeltshen, and Nidup, 2010; Kanna *et al.*, 2011). These residues are mostly used for domestic as well as industrial utility is inefficient due to following reasons (Grover and Mishra, 1996; Sumaran and Seshadri, 2010; Kanna *et al.*, 2011).

Wide range of sizes and moisture content

Difficult in controlling burning rate

Problems in mechanized continuous feeding systems

More amount of air pollution



Uncertain fuel characteristics such as Low calorific values, less energy density, high smoke emission and high ash content

Problems in logistics, distribution and storage

Poor understanding of value addition technologies

Irregular distribution and availability of biomass plantations

Lack of well organised trade and marketing structure

Unprecedented growing demand of renewable energy for domestic and industrial needs

These residues can be converted into useful energy derivatives technologies like combustion, bioethanol, biogas, gasification and pyrolysis etc. however, these constraints were most effectively overcome by the simple bio densification or briquetting technology by which increase in bulk density and high thermal values (Mythili and Venkatachalam, 2013).

Briquetting technology

Briquetting technology or briquetting is the process of applying pressure to a mass particles with or without binder converting into a compact product of high bulk density, low moisture, uniform size, good shape and uniform characteristics fuel (Bhardwaj, 2009; Sumaran and Seshadri, 2010; Kanna *et al.*, 2011). Briquettes can be produced with density of 1000-1200 kgm^{-3} compared to 30-150 kgm^{-3} of loose biomass and volume by 8-10 times reduced (Mythili and Venkatachalam, 2013). There are three types of technologies are

High pressure or compaction technology

Medium pressure technology

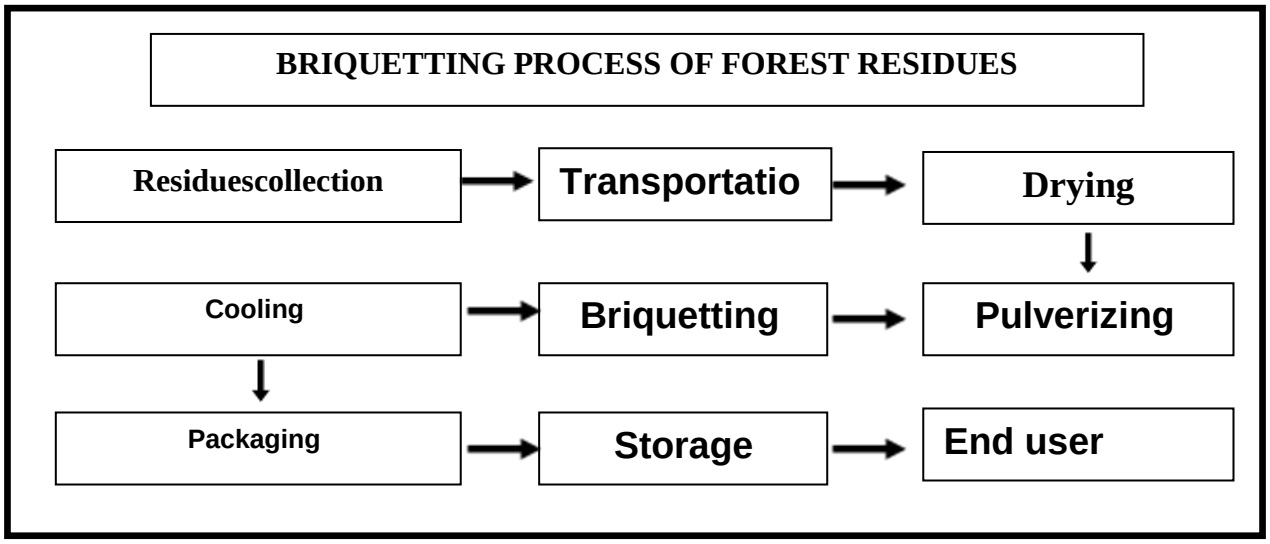
Low pressure technology

High pressure or compaction technology

In this 100 MPa pressure were applied with temperature of 200-250˚C. This leads to effective binding for briquettes so no need of additional binding material (Grover and Mishra, 1996). So this technology mostly preferred to high lignin content woody residues. It have two type of technologies are hydraulic piston press

and screw press (Grover, 1995). Hydraulic piston press technology or ram and die technology is the most common type technology in India in which biomass were pushed into the die by reciprocating ram with high pressure thereby compress into a briquette (Grover and Mishra, 1996). Ram will move 270 rpm and 60 mm diameter briquettes were produced. It needs a pressure of 110-140 Mpa.

Through screw press technology, can get superior quality briquettes with uniform size, effective combustion and more length. Feedstocks were compressed in the form of screw and will create carbonised outer surface with a hole at centre. This will helps to effective burning by easy flow of air.



Medium pressure technology

Pressure will be given in the range of 5MPa -100MPa with low heats. In medium pressure technology sometimes need an additional source of heating for lignin binding.

Low pressure technology

In this type machine were work in less than 5 MPa pressure and room temperature, which will needs additional binding material. It can be used in carbonised material.

Forest residues – raw material

All forest residues can be effectively briquetted. There is wide range of forest residues available are were branches, roots, barks, leaves and fruit shell, cutted waste from industries, saw dust from saw mills. Forest (wood) based sustainable than fossil fuel because briquettes combustion will emits CO_2 even though reforestation or regrowth will capture the CO_2 from the atmosphere. So use of briquetting technology is carbon-neutral. Moisture content ranges from 10-15 % and 4 % ash content is preferred.

Briquetting – processing technology

Forest residues collections

Feedstock preparation

Densification

Cooling and warehousing

Forest residues collections

All burning forest residues with convenient shape, size or form to be readily used as feedstocks.

Feedstock preparation

Collected feedstocks were dried (changes in moisture constant) using solar drier or

any other techniques to bring 10-15 % moisture content. Drying is essential for enhancing calorific value of briquettes. Dried feedstock`s size were reduced (change in surface area to volume ratio) by shredding, chopping, breaking rolling, sieving, hammering, milling, grinding, cutting etc. until it reaches a uniform sizes range from 1-10 mm. Suitable size of feedstocks were mixed with desired other feedstocks for maximum calorific value and good compaction of the briquettes. If needed binders were added to this.

Densification (density changes)

Mixed feedstocks were feed on the briquetting machines, based on preferred technologies. This process will helps to increase bulk density of residues for efficient burning, transportation and storage.

Cooling and warehousing

In high pressure technology, very high temperatures were used. So need to be cooled to room temperature and stored at suitable conditions.

Benefits of briquetting technology

- It can be utilised in wide range of domestic and industrial energy supply
- It produce low white smoke, no fly ash and low ash content
- Noise free, odour less and smokeless
- Uniform size and quality
- Helps to conserve the forest by providing substitute for woody fuel
- Net zero carbon emission (Carbon neutral) and eco friendly
- Improved heating efficiency and high calorific value per unit volume
- Easy handling and transport
- Less space to storing
- Reduces residues disposal problems and biodegradation of residues
- Year around production and user compatibility
- Effective utilisation of the surplus forest residues
- Increase rural employment and income generation to the farmer
- Specific density ranges from 1100-1200 kgm^{-3}
- Drastic increase in bulk density 1000-1200 kgm^{-3} from 30-150 kgm^{-3}

Applications

Briquettes are already used in domestic and industrial applications. Wide range of industries can use briquettes as low cost renewable energy such industries are tea factories, textiles factories, bioenergy generations, leather industries, brick kilns, chemicals and pharmaceuticals companies, tyre retreading industries, ceramic cluster, paper mills and rubber industriesetc

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Scope and potential of agroforestry in Chhattisgarh state, India

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Abstract

Agroforestry is the new concept for an ancient land use farming practices and just a compromised between agriculture and forestry. There scope and potential in any state comprises Chhattisgarh is very colossal. A large hectare area contributes agroforestry systems on boundaries, bunds and wastelands. Use of N_2-fixing trees like some leguminosae family comprises *Acacia spp*., *Dalbergia sissoo* etc., on their farmland for enhancement of their additional besides field crop and generating incomes with employment. Agroforestry model like Jatropha plantation is very prominent and farmers of Chhattisgarh are desirous to plant Jartropha species because it is easy to establish in anywhere and economically valuable in term of oil extraction and other uses. The state also aims at required forest covers of India under the national forest policy, which should be about 33% of the geographical area. In spite of these rural farmers are also interested in cultivation of lac, gum and resin yielding trees under the agroforestry model to attain rural basic requirements and enhancement of the socio-economic status. This is an attempt to compile and document information on scope and potential of different agroforestry model and role of tree-crop based these models in upliftment of living standard of rural farmers in Chhattisgarh.

Introduction

Chhattisgarh is a predominantly tribal region in the eastern part of India, comprising a total geographical area of 137.90 lakh ha, rich in forest and has a vast variety of minor forest products to favourable agro-climatic conditions resulting in good forest area, i.e. 43.6 % of the total. Rice is the main crop cultivated in most part of Chhattisgarh state. Agro-forestry as a land use system that integrates trees, crops and animals in a way that is scientifically sound, ecologically desirable, practically feasible and socially acceptable to the farmers (Nair, 1979). It is an old practice throughout the world, but the term recognized as a science few decades before. It necessitate cultivation of field crops results in maintaining productivity and fertility of land as well as improve socio-economic conditions of rural farmers by increased farm income and employment. According to Dhyani *et al*. (2013) in India the current area under agroforestry is estimated at 25.32 Mha, or 8.2% of total geographical area of the country. This includes 20.0 Mha in cultivated lands (7.0 Mha in irrigated and 13.0 Mha in rainfed areas) and 5.32 Mha in other areas such as shifting cultivation (2.28 Mha), home gardens and rehabilitation of problem soils (2.93 Mha). Moreover, agroforestry is also providing livelihood opportunities through lac, apiculture and sericulture cultivation and suitable trees for gum and resin have been identified for development under agroforestry (Dhyani, 2012). In the present scenario of climate change, agro-forestry

practices, emerging as a viable option for combating negative impacts of climate change (Singh *et al*., 2013). Chhattisgarh region is dominated with entisols (red laterite) and inceptisols, which gives minimal productivity. There is a need to find ways the increase productivity by planting woody perennial. This can be undertake with knowledge of choice of species and their role in different land use system which leads to influence both the rate and trajectory of rehabilitation process.

Agro forestry potential

Agro-forestry has been widely practiced all over the world especially in the developing countries. Agro-forestry has potential to improve the livelihoods of smallholder farmers in Chhattisgarh as by providing production services comprises fruit and nuts, fuel wood, timber, medicine, fodder for livestock, green fertilizers, assets that can be sold in times of need and additional/diversified income (WAC, 2010). The poor, particularly the rural poor, depend on nature for many elements of their livelihoods, including food, fuel, shelter and medicines (Jhariya and Raj, 2014). A worldwide initiative of agroforestry records indicates that it has the following potentials which includes availability of multiple products for farmers such as wood fuel, timber, poles, stakes, medicines, fodder, green manure or mulch, fruits or nuts, spices and resins, provides beneficial ecological services include wind speed reduction, soil temperature moderation, shade provision for certain crops and livestock, helps in carbon sequestration mainly by woody components and thus minimize adverse effect of climatic factors, watershed stabilization, soil erosion control and soil fertility improvement or maintenance, minimizing soil and nutrient losses in plain as well as sloppy land due to the deep rooting nature of the woody components which also uptake nutrients from deeper soil layers, improves microclimatic of area by lowering the soil temperature, better resistance in disease, insect, etc due to variety in crops in the systems, beautifying the agricultural landscapes and maximize production, improving biodiversity conservation domesticating wild trees and shrubs of high value and growing them on farm, provide rural employment opportunities and increases farm income, utilize wasteland and degraded land and aid industrial growth based on both agricultural and forestry raw materials.

Farmer's choice of tree species in Chhattisgarh

Trees most commonly found in fields are *Acacia nilotica, Butea monosperma, Terminalia arjuna, Neem, Karanj* etc. fruit trees like *Carica papaya, Citrus spp, Mangifera indica, Psidium guajava* are very common and popular in Chhattisgarh. Farmers gave a several reason why certain trees are left when the land is cleared or tended when they occurs naturally. The most common reason are that the tree provides fruit, medicine, wood and shelter are important to traditional of cultural beliefs and enhancement of the social and economic upliftment of the marginal farmers. Plantation of multipurpose trees (MPTs) species gives multiple benefits such as increasing productivity, ecosystem stability and biological diversity to degraded land. MPTs in the region include *Terminalia arjuna, T. tomentosa, Albizia procera, Mangifera indica, Butea monosperma, Zizyphus mauritiana, Azadirachta indica* (neem) and *Gmelina arborea* grown on paddy field bunds (Jhariya *et al*., 2015). Further due to

importance of neem in social forestry, agroforestry, reforestation and rehabilitation of the wasteland and degraded industrial lands it helps to combat desertification, deforestation and soil erosion and to reduce excessive global temperature (Jhariya *et al*., 2013).

Agro forestry model in Chhattisgarh

Different type of agroforestry model comprises Agri-silviculture system, Silvi-pasture model, Horti-silvicuture; Boundary plantations etc are practiced in the Chhattisgarh in order to meet his diverse needs. The combinations and crop types vary from region to region. Traditionally, farmers allow growing *Acacia nilotica* naturally at irregular spacing on the bunds of paddy fields or in combination with *Butea monosperma* and *Terminalia arjuna* etc. *Acacia nilotica*, being a multipurpose and nitrogen fixer species, is highly preferred by farmers and as a result, it is widely distributed in the field. In agroforestry model, a suitable combination of nitrogen fixing and multipurpose trees with field crops are played a major role in enhancement of better yield productivity, soil nutrient status and microbial population dynamics which plays a major role in nutrient cycling to maintain ecosystem (Raj *et al*., 2014a). As per Raj *et al*. (2014b) the soil biological attributes are also responsible for determination & maintenance of physical properties of soil.

Jatropha based plantation in Chhattisgarh

Jatropha Curcas L., is a small tree or large bush belonging to the Euphorbiaceae family (Achten *et al.,* 2008), fast growing, an easily established and drought-resistant plant. It is therefore well-adapted to semi-arid and arid conditions with suitable character for oil production, use as a live fence and for reclamation of eroded land (Kheira and Atta, 2009). Therefore due to this reason, small holding farmers are keen to planted and use Jatropha in agro-forestry model in Chhattisgarh state. According to the topographic, soil profile and prevailing agro-climatic condition of an area, Jatropha can be intercrop with other suitable species comprising the agricultural, horticultural, herbs, pastoral and/or silvicultural component to result in an ecologically viable, economically profitable and socially acceptable agro-forestry system. By evolving, promoting and adopting Jatropha based intercropping systems it is possible to improve the socioeconomics conditions in rural areas and to transform the National energy scenario and the ecological landscape.

It has been estimated that Chhattisgarh aims at becoming a bio- fuel self-reliant state by 2015 with the decision of planting 160 million jatropha saplings in all its 16 districts during 2006 (India eNews Pvt. Ltd, 2006). Chhattisgarh plans to earn Rs.40 billion annually by selling seeds after 2010. The Central government has provided Rs.135 million to Chhattisgarh in 2013 for developing Jatropha nursery facilities. Chhattisgarh plans to replace with Jatropha fuel all state-owned vehicles using diesel and petrol by 2007. Chhattisgarh Bio-fuel Development Authority now oversees the production of the *Jatropha curcas* seed as a rich source of bio-diesel (CBDA, 2007). Chhattisgarh government tie up with public sector company Indian oil to produce biodiesel and maintain Jatropha agro-forestry based plantation in Chhattisgarh name of this company Indian oil CREDA Biofules Ltd. Therefore, *Jatropha* is a highly economically important at the local level since under suitable management it has the potential to

grow in dry marginal non-agricultural lands, thereby allowing villagers and farmers to leverage non-farm land for income generation.

Lac hosts and production under agro-forestry in Chhattisgarh state

Chhattisgarh is one of the major lac producing states of the country. Lac was a subsidiary crop for the growers who depend on it for meeting cash expenses for house hold requirementsand family needs. Conventional tree hosts of lac like ber (*Zizyphus mauritiana*) and palas (*Butea monosperma*) can easily be integrated in bunds of cropped fields. The former species can be included in strips at the periphery of uplands. Ber can be established in about 3 years for lac cultivation.

Beneficial insects are one of the important economic components of forest ecosystem and for agroforestry. Culturing of these insects is attractive in terms economic returns as well as suitable for the land and culture of people of region. Other quick-growing bushy hosts like *Flemingia semialata* hold potential for integration in farming system models. *F. semialata* is quite promising for production winter kusmi lac under rainfed condition. It can be raised in the bunds easily for lac production. *Albizia procera*, which has been recently identified as lac host is also a good multipurpose tree for introduction in farmers and fields. Since returns through lac is higher than agricultural crops introduction of lac hosts in the farmers' field leads to overall improvement in returns. Thus lac cultivation can contribute towards income security while crops like paddy, vegetables, etc. can provide for nutritional security.

Silk and honey production in agroforestry

All the four known varieties of silk, viz., Mulberry, Tasar, Eriand Muga are cultivated in country. Among indian stats Chhattisgarh and Jharkhand gives higher production especially, Tasar and Mulberry silk. The plants used in the silk production, such as *Terminalia tomentosa* (asan), *Terminalia arjuna* (arjun) and *Shorea robusta* (sal) for tasar insect; the commonly used *Morus alba*, *Morus indica*, *Morus serrata* and *Morus latifolia* for mulberry insect; can be included in the agroforestry models. Central Tasar Research and Training Institute is already working on tasar host plant-based models of agroforestry.

India has four of the six reported honey bee species; *Apis dorsata*, *Apis cerana indica* and *Apis mellifera* (introduced) are mainly used in India for honey production. Honey bees are not only important for their honey but are also of paramount importance to agriculture production and plant diversity, as pollinators. CBRI has identified number of bee host plant according to different climatic conditions and purposes, which can be included in the agro forestry systems.

Gum yielding trees under agro forestry model

Gum trees are economically important and found in tropical moist and dry deciduous forests, produce a significant quantity of gum, which are widely used as industrial, food and medicinal purposes in India (Das, 2014). It is a one of the important non-timber forest produce (NTFP) and viable income sources for thousands of forest dwellers, especially tribals in India. Gum production is a pillar of family economy and considered as an income-generating source that requires only a low input of

work after the rainy season (Raj *et al*., 2015). As per Painkra *et al.* (2015) India is a rich diversity centre of medicinal and aromatic plants and plays an important role in supporting health care system in India. The major commercially important gums in good quantity are sourced from the central Indian forests, comprising of Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Orissa, Jharkhand and Bihar and to some extent Gujarat and Rajasthan. These central India forms one of the major ecosystems of the Indian subcontinent and constitutes a large tract of tropical dry deciduous and tropical moist deciduous forest type (Raj and Toppo, 2014; Toppo *et al*., 2014). *Acacia nilotica* gum is known as 'Indian gum Arabic'. It exudes from the wounds in bark. It generally exudes during March-May. It occurs in the form of rounded or ovoid tears and size up to 1cm and color varies from pale-yellow to brown or almost black (Raj, 2015a). Exploiting Babul tree for gum tapping will help farmers to strengthen their socioeconomic conditions as well as to help conserve environment and biodiversity too (Raj, 2015b).

Conclusion

Rural people should make some strategy for implementation of agroforestry model with suitable combination of trees and field crops and these combination is not only make the income generation for upliftment of living standardsbut also involves in maintaining ecological and environmental balance on sustained basis.i.e. emphasis should be more to more on scientific management of these models.

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Analysis of richness, diversity and eveness (she-analysis) of insect faunal population in teak-sal ecotone of Pachmari biosphere reserve, Madhya Paresh, India

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Abstract
Present paper deals about most abundant insect faunal species of Pachmari biosphere reserve (PBR) and variation in diversity pattern of insect species in teak – sal forest ecosystem with seasonal variations. Insect species like *Camopnotous, Aciagrion* sp., *Metochus uniguttattus* (Thunberg), *Creatonotus gangis* (Linn), *Ypthima* sp, *Myrimica* sp, *Gryllus assimilis* (Fabricius), *Ypthima* sp, *Clania crameri* (Westwood), *Scudderia furcata* (Braner), *and Lasius niger* (Linn.) are most abundant and adaptive insect species of Teak- Sal ecotone in PBR, on the basis of richness count. SHE analysis is made to analyze diversity pattern in both ways yearly and seasonally of insect species of PBR

Key words
SHE Analysis, Richness, Evenness index, Pachmari Biosphere Reserve, abundance of insect, Fauna of Pachmarhi.

Introduction
Pachmarhi area was designated as Biosphere Reserve by Government of India vide notification no J-220116/17/94-BR 3rd March 1999 (Anonymous 2001). PBR has varied spectrum variations of the latitude, altitude, rainfall, topography, soil. The altitude varies from 320 to 1352 m above MSL at different locations in the PBR area. (Anonymous 2001).The area has a typical monsoon climate with three distinct seasons of summer (March to June), rainy season (July to October) with heavy rains and cloudy climate and winter (November to February). The meeting zone of two major timber species sal and teak, formed ecotone zone (Shadangi and Nath, 2008) the Sal-teak mixture, is a rare phenomenon in PBR forests. Such ecotone occurs only in some areas of central India in Umariya, Pachmarhi Biosphere Reserve in Madhya Pradesh; Bastar, Raipur and Bilaspur in Chhattisgarh and Khariyar forests in Orissa. These junctions of teak and sal forests formed are known as ecotones or transition zones (Shadangi and Nath, 2008) .Sal forest zones localized at top hill (Pathak, 2001) .This area is dominated by sal trees.However some other plat species are associated like *Mallotus phillippenis, Mangifera indicia, Acbisia procera, Terminalia billerica, Grewia asilatical, Falcourita Indica, Gmelina arbourea, Syzgium cumini, some timber species like Buchinia vahlili, Dioscrea sp Celatrsus penicutala, Phyllanthus emblica , Cassia fistula ,Jasmine, Anogeissus pendula, Butea monosperma, Garcinia indica, Terminalia elliptica, Holoptelea integrifolia, Zizyphus jujuba*, are also associated with it .The teak (*Tectona grandis*) forest zones occur in mixed deciduous forest community. This patch is located at lower region of PBR and associated with, *Albizzia lebizzia, Chloroxyln swietenia, Pterocarpus*

marsupium, *Terminalia tometosa*. Zoological Survey of India in its recent publication "Fauna of Panchmarhi Biosphere Reserve" documentated 217 insect fauna of different order.

Material and method

Identification tool and agencies

a. **Online pictorial key**
   An attempt to develop a simple pictorial key was made for identification of specimens during field investigations.

b. **Identification**
   Insects collected during afore described surveys using various methods in PBR, insect were made identified by following authorized institutes:
   - Zoological Survey of India (ZSI), Jabalpur.
   - Forest Entomology Division, Tropical Forest Research Institute, Jabalpur

Field survey and observation

Faunal survey was made for analyzing, richness, abundance, density, evenness and diversity during year 2011-2013. Random sampling method was used for analysis of insect fauna of two different selected ecosystem communities with the help of standardized plots of 10 m X 10 m (Nair and Jaynarayan, 2005). Structure data were generated for all insect faunal species represented in sample plot which included insect faunal species of order Lepidoptera, Odonata, Hymenoptera, Hemiptera and Coleoptera. In order to study identification of insects, host status richness, abundance, density and diversity index work plan was divided in two parts i.e. identification of insects and calculation of population dynamics.

Calculation and analysis

For the sample analysis the data gathered from the sample plot were analyzed using the following formulae (Nair and Jaynarayan 2005,) evenness index (Kullu and Behera, 2012), SHE analysis (Bhattarya, 2015).

Richness (R) = Actual count of types of 'R'.

Abundance (A) = Total No of individuals / Total No of quadrate of occurrence

Density (D) = Total No of individual / Total No of quadrate sampled Species

Shannon diversity index (H') - Diversity indices were estimated using Shannon diversity index

$$H = \sum_{i=1}^{s} - (P_i * \ln P_i)$$

Where:

H = the Shannon diversity index

P_i = fraction of the entire population made up of species i

S = numbers of species encountered

$\sum$ = sum from species 1 to species S

Evenness index **(J)** – Eveness intex was estimated as per (Pielous, 1975) J = H/ln S

Where,

H= Shannon Diversity Index;

S = Total no. of species

Observation and result

Table 1: List of recorded insect species from Teak and Sal forest ecosystem

S.N.	Insect species from Teak and Sal forest ecosystem
1	*Ceriagrion coromandelianum* (Fabricius)
2	*Aciagrion* sp.
3	*Orthetrum sabina* (Dhury).
4	*Potamarcha congener* (Rambur)
5	*Crocothemis servilia servilia* (Dhury)

6	*Diplacodes trivialis* (Rambur)
7	*Neurothemis tullia tullia* (Dhury)
8	*Rhyothemis variegate variegate* (Linnaeus)
9	*Pantata flavescens* (Fabricius)
10	*Tramea basilaris burmeisteri* (Kirby)
11	*Urothemis signata signat* (Rambur)
12	*Oncocephalus schioedtei* (Reuter)
13	*Metochus uniguttattus* (Thunberg)
14	*Dysdercus koenigii* (Fabricius)
15	*Cydnus indicus* (Westwood)
16	*Riptortus linerris* (Fabricius)
17	*Ectrychotes dispar* (Reuter)
18	*Dictyophara Lineate* (Don)
19	*Papilio demoleus* (Linnaeus)
20	*Eurema brigitta* (Cremer)
21	*Eurema hecabae* (Linnaeus)
22	*Catopsilia sp.* (Linnaeus)
23	*Danaus chrysippus* (Linnaeus)
24	*Melatis leda* (Linnaeus)
25	*Junonia almanac* (Linnaeus)
26	*Junonia atlites* (Linnaeus)
27	*Junonia lemonias* (Linnaeus)
28	*Phalanta phalantha* (Dhury)
29	*Spialia galba* (Fabricius)
30	*Ypthima* sp (Moore)
31	*Chrysodeixis eriosoma* (Doubleday)
32	*Dysgonia sp.* (Fabricius)
33	*Mocis undata* (Fabricius)
34	*Othreis fullonica* (Linnaeus)
35	*Spodoptera litura* (Fabricius)
36	*Spirama retorta* (Clerck)
37	*Trigonodes hyppasia* (Cramer)
38	*Amata sp.* (Linnaeus)
39	*Creatonotus gangis* (Linnaeus)
40	*Macrobrochis gigas* (Walker)
41	*Agrius convolvuli* (Linnaeus)
42	*Theretra oldenlandiae* (Fabricius)
43	*Parotis* sp. (Hurber)
44	*Clania crameri* (Westwood)
45	*Eutectona machalis*(Walker)
46	*Scudderia furcata* (Braner)
47	*Gryllus assimities* (Fabricius)
48	*Gryllotalpa hexadectyla* (Petery)
49	*Herioglypus banian* (Fabricius)
50	*Tetxix areonosa* (Hancock)
51	*Hyblaea puera* (Cram.)
52	*Apis sp*
53	*Thethredo* sp
54	*Myrimica* sp
55	*Polistis* sp
56	*Lasius niger* (Linnaeus)
57	*Camopnotous* sp
58	*Alissonotum sp.*
59	*Onthophagus dama* (Fabricius)
60	*Onitis philemon* (Fabricius)
61	*Anamala* sp
62	*Adoretus* sp.
63	*Holotrichia sculpticollis* (Blanchard)
64	*Holotrichia* sp
65	*Onthophagus* sp.
66	*Hoplocerambyx spinicornis* **(**Newman)

Seasonal variation in richness of insect species in sal forest ecosystem

During winter season, in sal forest ecosystem most abundance species(fig-1) observed are; *G. assimities*, (386.7),followed by *Ypthima* sp. (296.7), *U. s. signat* (279.7), *Anamala* sp. (270), *C. ceremeri* (266.7), *L. niger* (211.3), *P. flavescens* (209.7), *T. areonosa* (208.3), *P. congener* (207), *O. Sabina* (204.3), *T. b. burmeisteri* (201.7), *Camponotus* sp. (201), *S. furcata*, (197.7), *O. dama* (193), *E. hecabae* (190.7), *C. coromandelianum* (187.7), *S. retorta* (185.3), *S. litura* (180), *Thethredo* sp. (179.7), *O. philemon* (179.3),*O. philemon* (179.3), *D. chrysippus* (176.7), *S. galba* (175) and during summer season**;***G. assimities* (136), followed by *L. niger* (101), *T. areonosa*

(91), *Camponotus* sp. (73.3), *Holotrichia* sp. (70), *Myrimica* sp. (68.3) *H. sculpticollis* (68) *S. furcata* (66) *Polistis* sp (64.7) . In summer 15 insects species found frequently occoured ;are *Anamala* sp. (58), *C. gangis* (55.7), *Ypthima* sp. (54), *T.hyppasia* (53), *Onthophagus* sp. (50), *D.koenigii* (45.3), *S. retorta* (42.7), *T. oldenlandiae* (42.7), *Thethredo* sp. (42.7), *C. s. servilia* (40.3), *D. chrysippus* (38.7), *C. eriosoma* (38.3), *Amata* sp. (35.3), *S. viteripennis* (34), *Adoretus* sp. (34). During rainy season most abundant insect species observed are; *Dysgonia* sp (204.7), followed by *O. schioedtei* (175.7), *P.flavescens* (175.7), *S. galba* (174.7), *Alissonotum* sp. (165), *T.b.burmeisteri* (148.3), *J. atlites* (121.3), *G. hexadectyla* (119), *C. gangis* (112.7), *C. eriosoma* (109.7), *C.Ceremeri* (107.3), *Aciagrion* sp. (105.3).

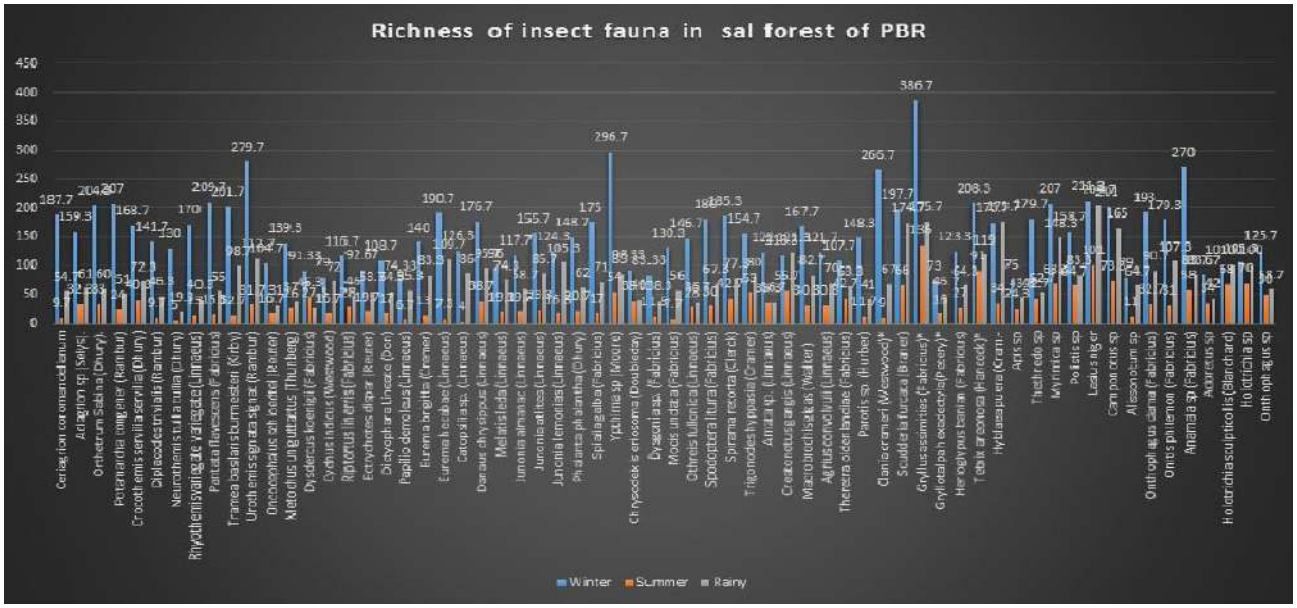

Fig.1 Richness of insect species in sal forest ecosystem

Seasonal variation in richness of insect species in teak forest ecosystem

During winter season, in Teak forest ecosystem most abundance species (fig-2) observed are; *C.Ceremeri* (323.7) followed by *P. congener* (266.3) *G.*assimities (263.0) *S.*viteripennis (241.0) *Camopnotous* sp (237.3) *T. b.burmeisteri* (232.0) *P.* flavescens (230.7) *U. s. signat* (222.3) *H. sculpticollis* (218.0) *R.v.variegate* (207.3) *Myrimica* sp (207.3) *C.s. servilia* (201.7) *Aciagrion* sp (198.0) *C.* eriosoma(196.3) *Ypthima* sp (195.3) *S.*furcata (192.0) *T.areonosa* (191.7) *E.* machalis (187.7) *H.* sprinicro (185.3) *O.*sabina (178.3) *L. niger* (174.7) *S.*galba (173.7), *M.* uniguttattus (167.0) *O. philemon* (166.7) *D.*trivialis (165.7) *C.* gangis (164.7). During summer most abundant; *A.*convolvuli (149.0) followed by *C. indicus* (147.5) *S. furcata* (141.7) *G. assimities* (137.7) *C. s. servilia* (129.3) *O.schioedtei* (127.0) *Ypthima* sp(124.5) *M.uniguttattus* (119.0) *C.gangis* (115.0) *P. congener* (105.7) *D. trivialis* (105.0) *M. gigas* (99.3) *O.sabina* (94.0) *N.t. tullia* (90.0) *T.hyppasia* (90.0) *Amata* sp (90.0) *S. retorta* (87.5) *Aciagrion* sp(77.7) .During winter most abundant; *Myrimica* sp (210) followed by *Camopnotous* sp

(206.3) *Ypthima* sp(174.7) *G.*assimities (158.0) *Holotrichia* sp (153.3),*S. viteripennis* (142.7) *D.koenigii* (138.0) *J.* atlites (128.0) *O.philemon* (122.3).

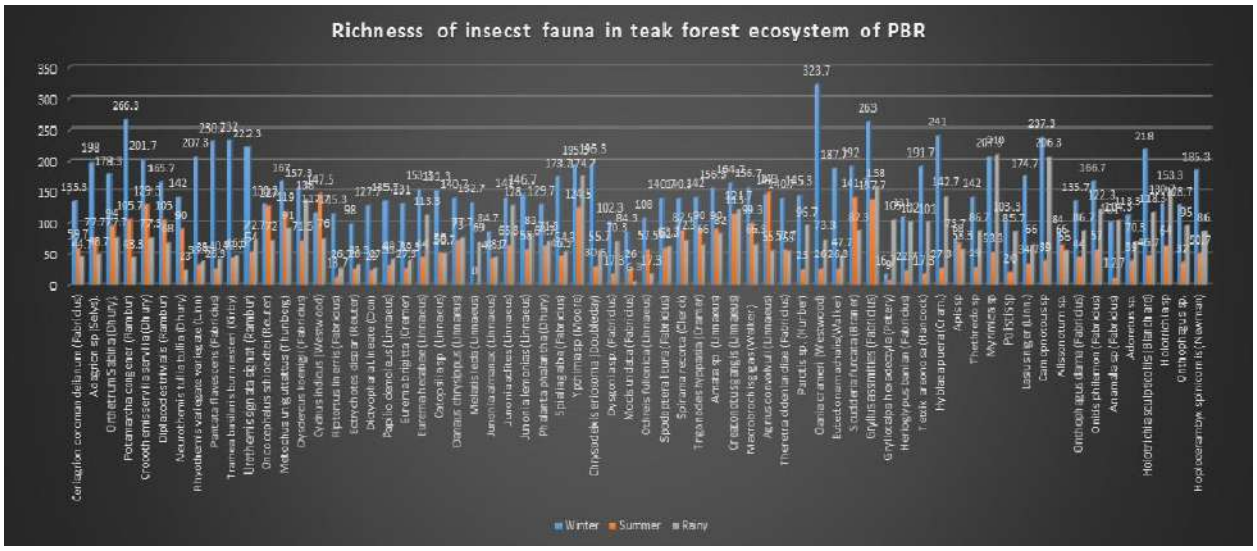

Fig. 2 Richness of insect species in teak forest ecosystem

On the basis of mean value (Fig 1 & 2) it is interpreted that richness in variation is comparable of Teak and Sal forestss. In Sal forest ecosystem, during winter 23.4 % insect species are dominant followed by 18% in rain and 5.25% in summer. Simultaneously in Teak forest ecosystem, during winter 40.6 % followed by 27% in summer 19% in rain.

Diversity index and evenness index sal and teak forest ecosystem year wise (2011-2014)

Sal and Teak forest ecosystem of Pachmari Biosphere Reserve lies in Tropical climate. Diversity index and evenness index of insect species is 1.7 and 0.9 respectively for both the forest ecosystems (table 2). Diversity index value 1.7 shows, highest diversity status of insect species in forest. Evenness index for topical forest is highly significant, evenness index for tropical and sub-tropical forest ranges between 0-3.

Diversity index and evenness index sal and teak forest ecosystem season wise

Diversity index rangers from 0.24 to 1.64 seasonwise, this variation caused due to variation occurred in species richness (3.3 to 4.0) and evenness index (0.0 to 0.9) (table 3 to 4). In both the forests highly variation occurred in evenness (table 3) due to seasonal change. It indicates role of climate factor like temperature humidity in contributing diversity status of Sal and Teak forest ecosystem of Pachmari Biosphere Reserve.

SHE analysis (year wise, 2011-14)

SHE analysis (table 2) revealed a clear distribution of two ecosystems of insect species richness (S), diversity (H) and evenness (E) in Pachmarhi Biosphere reserve. Analysis indicate (fig 3 & 4) that $H'_1 \sim H'_2$, $S_1 \sim S_2$, $E_1 = E_2$ are similar (Buzas, Hayek 1996 and 1998); Wilson et al. 2010), (where 1 and 2 in suffix are any two population).(Buzas Hayek, (1996 and 1998) pointed out that often the diversity (H') changes because the differences between richness (S) and evenness (E) do not offset each. In Pachmarhi Biosphere

reserve S1~S 2, E1= E2 (Similar), therefore diversity of both ecosystem is H'1 ~ H'2 (Similar). SHE analysis in to Sal and Teak forest ecosystem was significantly not comparable .The diversity pattern in both ecosystems is similer.It may be due to plenty of food resource, host plant habitat, suitable niche, and temperature available for insect species accorded in Teak-Sal ecotones are polyphagous, so they are flourishing in similar extent. It may also that, the junctions of Teak and Sal forests (ecotones) (Shadangi and Nath 2008) are nearest of each other. So ecological attributes like migration and natality is more dynamic, which contributes to similar diversity index,

Table 2: Year wise *SHE* analysis of insect species population in two diffent Sal and Teak forest ecosystem of PBR (Kullu and Behera, 2012; Hayek and Buzas, 1997).

Year	SHE analysis of sal forest ecosystem (E_1)			SHE analysis of teak forest ecosystem (E_2)		
	LnS_1	H'_1	LnE_1	LnS_1	H'_1	LnE_1
2011-12	4.024	1.755	0.977	4.261	1.78345	0.983
2012-13	4.136	1.798	0.988	4.331	1.78843	0.983
2013-14	4.338	1.784	0.983	4.352	1.7759	0.977

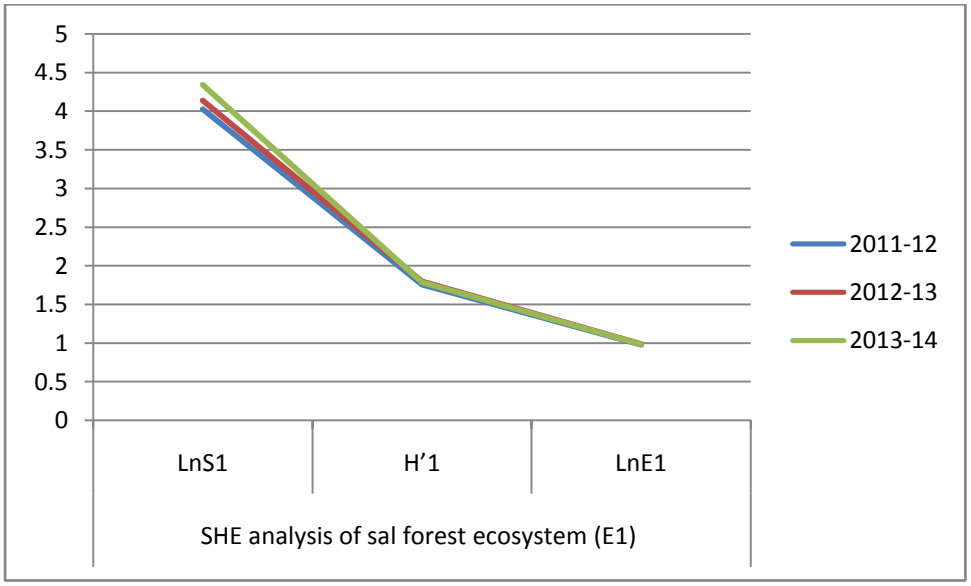

Fig 3: Year wise *SHE* plot for insect population Sal forest ecosystem (E_1) of PBR

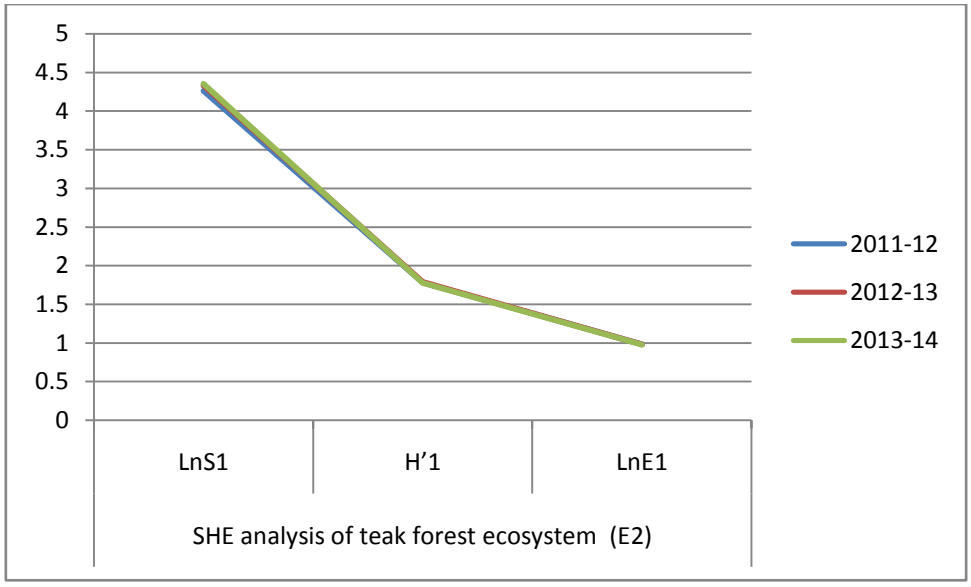

Fig 4: Year wise *SHE* plot for insect population in Teak forest ecosystem (E_1) of PBR

SHE analysis (Season wise, 2011-14)

SHE analysis (table 2) revealed a clear distribution of two ecosystems of insect species richness (S), diversity (H) and evenness (E) in the three different season seasons. Analysis indicate s that in winter, summer and rainy seasons H'1 ~ H'2, S1≠S 2, E1≠ E2; H'1 ≠ H'2, S1≠S 2, E1≠ E2 and H'1 ~ H'2, S1≠S 2, E1≠ E2 respectively (Buzas, Hayek 1996 and 1998); Wilson et al. 2010) .In winter, in Sal forest ecosystem species were not shown significant evenness (table 2). It is also observed that yearly, SHE analysis in to Sal and Teak forest ecosystem was significant as comparable to season wise SHE analysis. Diversity pattern changes in ecosystem as per seasonal changes. However in winter season was H1~H2 .It may be due to plenty of food resource, host plant habitat, suitable niche, and suitable temperature. It may also that, the junctions of Teak and Sal forests (ecotones) (Shadangi and Nath 2008) are nearest of each other so they migrate to the adjacent ecosystem area.. It reveals that in species accorded in Teak-Sal ecotones are polyphagous, so they are flourishing each other. (Buzas Hayek, 1996 and 1998) pointed out that often the diversity (H') changes because the differences between richness (S) and evenness (E) do not offset each other and such SHE plot is log normal one (fig 5 & 6). Difference observed in H'1 ≠ H'2, during summer and rainy seasons, in teak-sal ecotones, which indicate the change in diversity of the population.

Table 2: SHE analysis of insect species population season wise of in two diffrent sal and teak forest ecosystem. (Kullu and Behera, 2012; Hayek and Buzas, 1996, 1998; Wilson et al. 2010)

Seasons	SHE analysis of sal forest ecosystem			SHE analysis of teak forest ecosystem		
	lnS_1	H'_1	lnE_1	lnS_2	H'_2	lnE_2
Winter	3.998	0.57	0.031	4.015	0.54	0.296

Summer	3.334	0.64	0.334	3.598	0.78	0.428
Rainy	3.694	1.68	0.928	3.719	0.24	0.134

(Note -that species evenness s ranges from zero to one, with zero signifying no evenness and one, a complete evenness.)

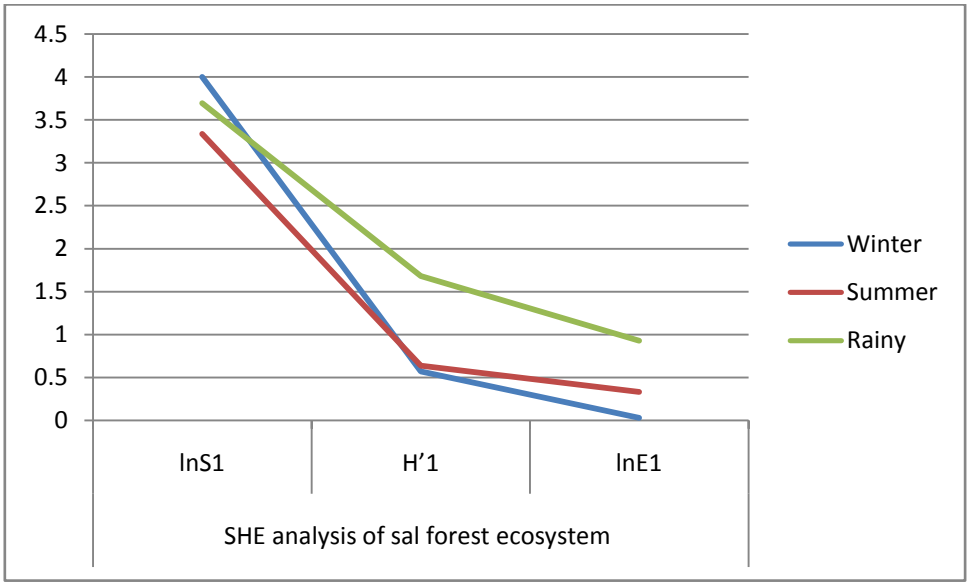

Fig 5 (a): Seasonal *SHE* plot for insect population of Sal forest ecosystem in different seasons

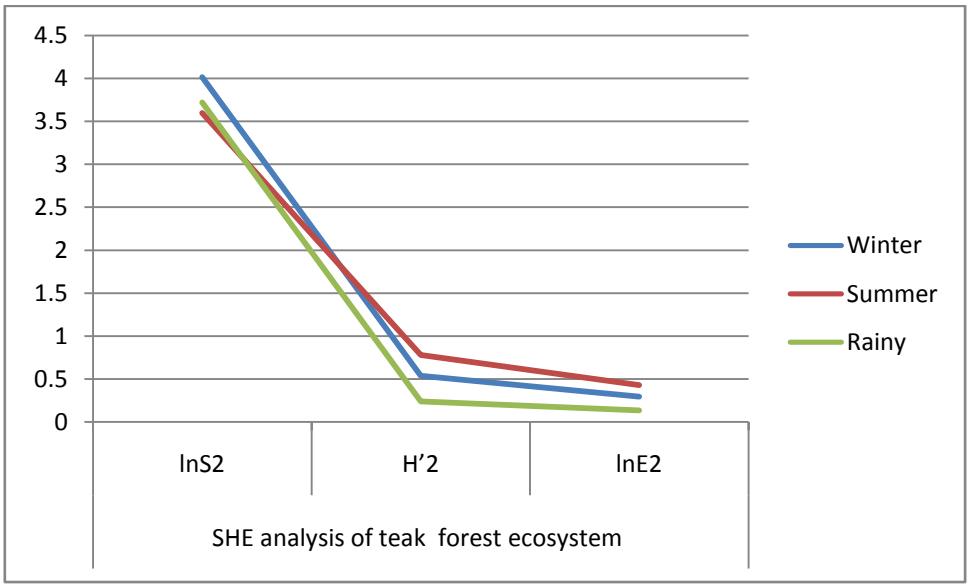

Fig 5 (b): Seasonal *SHE* plot for **insect population of teak forest ecosystem in different Seasons.**

Discussion

Estimation of evenness of insect species stands at 0.9, which is significant for in tropical forest climate. PBR has unique transition of Teak –Sal forests which is said as Teak –Sal ecotones. Though is dominated by trees of teak and sal, still it is a hub for diverse insect fauna. SHE analysis supports that seasonally diversity of insect fauna shows variation.Seasonaly diversity index of insect fauna in teak sal ecotone shows high variation. **.** Diversity is controlled by richness and evenness. Highest richness value indicates highest

abundance of species in teak sal ecotone. Present analysis of richness show that most adapted species in this transitional area are ; *Camopnotous sp ,Aciagrion* sp ,*M.* uniguttattus , *C.* gangis *Ypthima* sp *Myrimica* sp , *G. assimities, Ypthima* sp *C. ceremeri , S. furcata, L. niger* .

Conclusion

Entomofaunal survey was made in PBRs teak and sal forest ecosystem .Diversity of insect fauna was recorded and SHE analysis made to determine diversity of insect fauna of PBR. Diversity index of insect faunas is estimated 1.7, is highest. Among 66 recorded insect species 11 were observed most abundant in area with seasonal variation viz *Camopnotous ,Aciagrion* sp ,*M.* uniguttattus , *C.* gangis *Ypthima* sp *Myrimica* sp , *G. assimities, Ypthima* sp *C. ceremeri , S. furcata, L. niger*,on the basis of richness count.

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कामगंध सापळे : कीट निरिक्षण व नियंत्रणासाठी उपयुक्त

शालिनी भोवते
वानिकी अनुसंधान एवं मानव संसाधन विकास केंद्र, छिंदवाडा

आज पर्यावरण प्रदूषण तसेच कीटनाशकांच्या दुष्परिणामामुळे मानव असाध्य रोगांना बळी पडत आहे. प्राथमिक किडींमधे वाढलेली प्रतिकार शक्ती, दुय्यम किडींचा उद्रेक अशा अनेक समस्या आढळून येत आहेत. साधारणत: पतंग वर्गीय किडींच्या नियंत्रणासाठी कीटनाशकांचा वापर अधिक होत असतो; याचा पिकातील मित्राकीटकांच्या संख्येवरही परिणाम आढळून येतो.त्यामुळे रासायनिक कीटनाशकांवर नियंत्रण ठेऊन एकात्मिक कीड व्यवस्थापना तील अन्य घटकांचा वापर करणे फायदेशीर ठरते. कारण त्याद्वारे किडींची पातळी कमी करून निसर्गाचा समतोल राखण्यास मदत होते. एकात्मिक कीड व्यवस्थापनात पतंग वर्गीय किडींच्या नियंत्रणासाठी अरासायानिक घटकांमधे कामगंध सापळयांचा वापर केल्यास कमी खर्चात कीड नियंत्रण होण्यास मदत होते. शेतातील तसेच रोपणी/रोपवनातील पतंग वर्गीय किडींना आर्थिक नुकसान पातळीच्या खाली ठेवण्यासाठी कामगंध सापळयांचा वापर फायदेशीर ठरतो.किडींचे सापळया द्वारे निरीक्षण करून योग्य एकात्मिक व्यवस्थापन कार्यक्रम करण्यासाठी हा प्राथमिक उपाय आहे.ज्यामुळे लक्ष्य किडींचे योग्य वेळी योग्य पद्धतीने नियंत्रण करून पिकांचे संरक्षण करण्यास मदत होते.

कीटक सुसंवाद किवा संबंध साधण्यासाठी शरीरातून एक विशिष्ट प्रकारचा गंध सोडतात, या रासायनिक गंधामुळे त्यांच्या मधे विशिष्ट प्रतिक्रिया निर्माण करून संदेशवहनाचे कार्य करतात. या गंधाने विरुद्ध लिंगी कीटक परस्पराकडे मिलनासाठी आकर्षित होतात त्यामुळे या गंधाला कामगंध (फेरोमोन) असे म्हणतात.काही किटका मधे नर किटक नर व मादी कीटकांना आकर्षित करतात तर काही मधे मादी कीटक नर कीटकांना आकर्षित करतात.

कामगंध सापळे म्हणजे एक कीटक पिंजऱ्याचा प्रकार आहे ज्यात किडीनुरूप गंध ठेऊन (आमिष दाखवून) किडींना आकर्षित करण्यासाठी वापरले जाते.जसे डेल्टा सापळा, पॅन सापळा, फनेल सापळा इत्यादी.

कामगंध किडीनुरूप वेगवेगळे असतात अशा कीटकांच्या सवयी लक्षात घेऊन कृत्रिम कामगंध सापळे तयार केले जातात.बाजारात वेगवेगळया प्रकारचे सापळे व किडीनुरूप गंध (ल्यूर) तयार मिळतात अशा प्रकारातील सापळयात कृत्रिम गंध लावण्याची सोय असते.कामगंध सापळे प्रमाणित केलेल्या मात्रेनुसार लावल्याने लिंग कामगंध रसायनांचे सूक्ष्मकण वातावरणात पसरतात.या सापळयांची रचना अशी असते की प्रौढ पतंग गंधा कडे आकर्षित झाल्या नंतर त्यात तो अडकून पडतो त्यास बाहेर पडणे शक्य होत नाही. असे जमा झालेले पतंग नंतर सापळयात मरतात. नर व मादी किडींचे मिलन न झाल्यामुळे प्रजोत्पादन होऊ शकत नाही व पूढील पिढी तयार होण्याच्या प्रक्रियेत बाधा येते.

काही कामगंध सापळे

फनेल ट्रॅप –अशा प्रकारच्या सापळयात हेली ल्युअर (हिरवी बोंड अळी), कापूस, तूर मका, वाटणा इ.पिकांसाठी तसेच स्पोडो ल्युअर (पाने खाणारी अळी) सोयाबीन, कापूस, भुईमुग तंबाखू, सुर्यफुल इ. पिकांसाठी, आणि एरीन

फनेल ट्रॅप

ल्युअर (काटेरी बोंड अळी) कापूस या पिकावरील किडींच्या व्यवस्थापनेसाठी उपयोग होतो. किडींच्या प्रादुर्भावानुसार एकरी ५-७ सापळे बसवणे तसेच दर २१ दिवसांनी ल्युर बदलणे फायदेशीर ठरते.

फ्लाय टी ट्रॅप

अशा प्रकारच्या सापळयात बाक्यू ल्युअर चा वेलवर्गीय पिकांवरील फळमाशीच्या तसेच बँडोर ल्युअर चा फळझाडा वरील फळमाशीच्या व्यवस्थापनेसाठी उपयोग होतो. किडींच्या प्रादुर्भावानुसार प्रती एकर ०६ सापळे बसवणे तसेच दर ६० दिवसांनी ल्युर बदलणे फायदेशीर ठरते.

वोटा टी ट्रॅप

अशा प्रकारच्या सापळयात उसावरील खोड किडा तसेच कांडी अळी च्या व्यवस्थापनेसाठी ल्युअर वापरले जाते. एकरी ६-८ सापळे बसवणे फायदेशीर ठरते.

वोटा टी ट्रॅप

कामगंध सापळे वापरण्याची पद्धती

१) पाण्याने अर्धा सापळा (ट्रॅप) भरावा. गंध (ल्यूर) सापळयामध्ये घट्ट बसवावे किवा तारेच्या अथवा जाड धाग्याच्या सहहाय्याने झाकणातून आत सोडावे.

२) सापळयाचे झाकण बंद करावे.

३) सापळा वेळू अथवा निमुळते टोक असलेल्या काठीला जोडून बसवावा किंवा झाडांच्या फांदीला लटकवावा. पिकांच्या उंचीप्रमाणे सापळा बसवावा.

४) वेगवेगळया किडींसाठी सापळे कमीतकमी ३ मीटर अंतराने ठेवावे. कीट निरीक्षणासाठी २-३ सापळे एक हेक्टर क्षेत्रफळ जागेसाठी पुरेसे असतात.

५) कीटका नुसार वेगवेगळे ल्यूर असतात तसेच त्यांची वापरण्याची पद्धतीही सापळयानुसार असते.

कामगंध सापळ्याचे फायदे

1) किडींचे प्रमाण ज्यावेळी अतिशय कमी असते अशा वेळी पतंग पकडण्यासाठी सापळ्याचा चांगला उपयोग होतो.
2) कीट नाशक फवारणी साठी लागणारा खर्च टाळता येतो.
3) किडींची आर्थिक नुकसानीची पातळी ठरवून योग्य वेळी कीट नाशकाची फवारणी करून नियंत्रण करणे शक्य होते.
4) कामगंध सापळ्याचा वापर केल्यामुळे परोपजीवी मित्र कीटक सुरक्षित राहतात तसेच त्याच्या संख्येतही वाढ होते व नैसर्गिक नियंत्रणाचे चक्र क्रियाशील राहते.
5) सापळ्या तील वापरलेले रसायन (ल्युर) हे पर्यावरणावर कोणतेही घातक परिणाम करत नाही.
6) विविध पिकांमधे कीट नियंत्रणाची कारवाई केव्हा सुरु करावी हे समजण्यासाठी उपयोग होतो.

सापळे वापरतांना घ्यावयाची काळजी

- दोन सापळ्यातील अंतर साधारणत: २० मीटर ठेवावे. शेताच्या आकारमानानुसार हे कमी जास्त करावे.
- साधारणतः सापळा पिकांच्या उंचीपेक्षा उंच ठेवावा.
- सापळ्यातील ल्युर प्रमाणित केलेल्या दिवसाच्या अंतराने बदलावे.
- सापळा वारयाचा दिशेला समांतर असावा ज्यामुळे सापळ्यातील रसायनांचे सूक्ष्म कण शेतात पसरून किडींचे जास्तीत जास्त पतंग सापळ्या कडे आकर्षित होतील.

The wild leafy vegetables of Telangana state and their importance in modern food security systems

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Abstract

The present report is concentrated on the documentation and conservation of traditional wild food plants used by rural, folkloric people of south districts of Telangana State, India. A total of 61 species were recorded as wild leafy vegetable plants. Of those species, 11 species belongs to the Amaramthaceae, 12 species representing each of 04 from three families, followed by 03 species of single family Verbenaceae, 16 species representing each of 02 from 08 families and 19 families representing single species from each of them. The maximum, herbs were in the information are considered. In the present results the importance of the wild leafy vegetables plants wisdom has been observed. Except efforts are ended to educate the further generations about their importance, it may be vanished in future. This kind of reports could donate extensively in Government policies to progress food security in rural, folkloric areas, and in the improvement of wild vegetable importance in food security system.

Introduction

The worth of wild edible vegetables in food sanctuary has not been specified sufficient consideration in India. Therefore, there are no formal interventions that seek to encourage people to use traditional vegetables as sources of essential nutrients. For many years the importance of wild plants in subsistence agriculture in the developing world as a food supplement and as a means of survival during drought and famine has been overlooked. Nevertheless, whereas the rich indigenous knowledge on the medicinal use of wild plants has been relatively well documented, research, particularly concerning the socio-economic, cultural, traditional, and nutritional aspects of wild food plants still lacks adequate attention. There are at least 3000 edible plant species known to man, with merely 30 crops contributing to more than 90% of the world's calorie intake, and only 120 crops are economically important on a national scale (Cooper *et al*., 1996).

There are in 1532 edible wild food species in India, mostly from Western Ghats and Himalayan regions (Arora and Pandey, 1996). Likewise, in Eastern Ghats region also, several tribals are using wild plants as food. Tribal people of Andhra Pradesh are endowed with a deep knowledge concerning the use of wild plants as food purposes. Tribals constitute an important part of the population of India, representing about 8% of the total population; it is about 6% of the total population of Andhra Pradesh (Anon, 2001).

Methodology

A number of field trips were undertaken in south districts of study area (Fig. 1). At each one time of trip, diverse folkloric and forest or rural people's information was collected in different seasons. The information was accrued after discussions with several users like village head, elder

women and other local informants. Repeated interviews through questionnaires were made in different villages to authenticate the information. Plant specimens were collected and identified with regional floras (Sachchidananda and Prasad, 1998; Gamble, 1928; Pullaiah and Chennaiah, 1997; Pullaiah and Moulali, 1997; Pullaiah, 2005).

Study area

Telangana State is one of the 29 states of India. It was separated from the erstwhile Andhra Pradesh on 2nd June 2014. Telangana State is situated in the central stretch of the eastern seaboard of the Indian Peninsula. Telangana state has an area of 114,840 square kilometers (44,300 sq mi). The area is divided into two main regions, the Eastern Ghats and the plains. Telangana lies between 15 50' – 19 55' North latitudes and 77 14' – 78 50' East longitudes. Telangana is bordered by the

Figure 1: Study area: Telangana state

states of Maharashtra to the north and north-west, Karnataka to the west, Chhattisgarh to the north-east and Odisha to the east and Andhra Pradesh to the south. The state is drained by two major rivers, with about 79% of the Godavari river catchment area and about 69% of the Krishna catchment area, but most of the land is arid. It is an extensive plateau with an average elevation of about 400 m above sea level. This plateau consists mainly of the ranges of erosion surface: (i) above 600 mt, (ii) from 300 – 450 mt and (iii) from 150 – 300 mt. The State Telangana has the monsoon type of tropical climate. On the whole State enjoys warm climate. In northern Telangana tropical rainy type of climate prevails. Hot Steppe type of climate is noticed in the southern parts of the State. In Tropical Rainy type, the mean daily 0 temperature is above 20C with an annual rainfall of 150 to 200 cms, mostly in summer and South-West monsoon. In the Hot Steppe type, the mean daily temperature is 18C and less. In the state of Telangana Maximum temperature in the summer season varies between 37C and 44C and minimum temperature in the winter season ranging between 14C and 19C. The State has a wide variety of soils and they form into three broad categories - red, black and laterite. The type of forests met within Telangana, as per the classification of Champion and Seth (1968) are Tropical moist deciduous forests, Southern dry deciduous forests, Northern mixed dry deciduous forests, Dry savannah forests and Tropical dry evergreen scrub (Pullaiah, 2015).

In Telangana state there is about more than 20 tribes were recorded. Commonly they are located hilly and interior forest areas. The research report focusing on a number of the important wild food plants, which needs to be documented for food security in future.

Results

A total of 61 species were recorded as wild leafy vegetable plants from Telangana state (Table: 1). Out of these species, 11 species belongs to the Amaramthaceae, 12 species representing each of 04 from three families, followed by 03 species of single

family Verbenaceae, 16 species representing each of 02 from 08 families and 19 families representing single species from each of them. The maximum, herbs were in the information are considered. In the present results the importance of the wild leafy vegetables plants wisdom has been observed. Except efforts are ended to educate the further generations about their importance, it may be vanished in future. This kind of reports could donate extensively in Government policies to progress food security in rural, folkloric areas, and in the improvement of wild vegetable importance in food security system.

Table 1: Wild leafy vegetables of Telangana state

SN	Family	Botanical name	Local name
1.	Acanthaceae	*Hygrophila auriculata* (Schum.) Heine	*Neeru gobbi*
2.	Aizoaceae	*Trianthema decandra* L.	*Tella galijeru*
3.	Aizoaceae	*Trianthema portulacastrum* L.	*Galijeru*
4.	Alangiaceae	*Aeschynomene aspera* L.	*Neerjilugu*
5.	Amaranthaceae	*Achyranthes aspera* L.	*Uttreni*
6.	Amaranthaceae	*Aerva lanata* (L.) Juss.	*Konda pindi*
7.	Amaranthaceae	*Allmania nodiflora* (L.) Wt.	*Nagali kura*
8.	Amaranthaceae	*Alternanthera paronychioides* St. Hil.	*Ponnaganti*
9.	Amaranthaceae	*Alternanthera sessilis* (L.) DC.	*Ponnaganti kura*
10.	Amaranthaceae	*Amaranthus spinosus* L.	*Doggali*
11.	Amaranthaceae	*Amaranthus tricolor* L.	*Totakura*
12.	Amaranthaceae	*Amaranthus viridis* L.	*Chirryaku*
13.	Amaranthaceae	*Celosia argentea* L.	*Gunugu*
14.	Amaranthaceae	*Digera muricata* (L.) Mart.	*Chenchulaaku*
15.	Amaranthaceae	*Nothosaerva brachiata* (L.) Wt. & Arn.	*Akkura*
16.	Apiaceae	*Centella asiatica* (L.) Urban	*Saraswathi aku*
17.	Araceae	*Colocasia esculenta* (L.) Schott. & Endl.	*Chama*
18.	Araceae	*Lasia spinosa* (L.) Thw.	*Neerugaddalu*
19.	Arecaceae	*Amorphophalus paenofolius* (Dennst.) Nicolson	*Adavi kanda*
20.	Asclepiadaceae	*Caralluma adscendens* R.Br.	*Kundaetikommulu*
21.	Asclepiadaceae	*Caralluma attenuata* Wt.	*Moulya*
22.	Asteraceae	*Gnaphalium polycaulon* Pers.	*Gorlalumu*
23.	Barringtoniaceae	*Barringtonia acutangula* (L.) Gaertn.	*Barrenka*
24.	Bombacaceae	*Bambusa arundinacea* (Retz.) Roxb.	*Veduru*

25.	Bombaceae	*Bombax ceiba* L.	*Buruga*
26.	Caesalpiniaceae	*Cassia italica* (Mill.) Andr.	*Nela tangedu*
27.	Cleomaceae	*Cleome gynandra* L.	*Vaminta*
28.	Convolvulaceae	*Ipomoea aquatica* Forssk.	Tuuti kaada
29.	Convolvulaceae	*Rivea ornata* Choisy	*Boddi kura*
30.	Erythroxylaceae	*Erythroxylum monogynum* Roxb.	*Dedadaaru*
31.	Euphorbiaceae	*Antidesma acidum* Retz.	*Pulleru*
32.	Euphorbiaceae	*Breynia vitis-idaea* (Burm. f.) C. Fischer	*Pisangi*
33.	Euphorbiaceae	*Euphorbia heterophylla* L.	*Saarni koora*
34.	Euphorbiaceae	*Euphorbia hirta* L.	*Reddivaari nanabaalu*
35.	Hydrophyllaceae	*Hydrolea zeylanica* (L.) Vahl	*Alumu*
36.	Lamiaceae	*Anisochilus carnosus* (L.f.) Benth.	*Kodipunjuchettu*
37.	Lamiaceae	*Leucas aspera* (Willd.) Link	*Tummi kura*
38.	Malvaceae	*Malvastrum coromandelianum* (L.) Garcke	*Chirubenda*
39.	Melastomataceae	*Melastoma malabatricum* L.	*Dayyamchettu*
40.	Menispermaceae	*Cocculus hirsutus* (L.) Diels	*Dusseru*
41.	Menispermaceae	*Tinospora cordifolia* (Willd.) Hook.f. & Thoms.	*Bael tiga*
42.	Mimosaceae	*Neptunia oleracea* Lour.	*Attipatti*
43.	Myrsinaceae	*Ardisia solanacea* Roxb.	*Chavvalakura*
44.	Nyctaginaceae	*Boerhavia diffusa* L.	*Atuka mamidi*
45.	Oxalidaceae	*Oxalis corniculata* L.	*Pulichinta*
46.	Papilionaceae	*Abrus precatorius* L.	Yerra gurija
47.	Papilionaceae	*Atylosia scarabaeoides* (L.) Benth.	Konda kandi
48.	Papilionaceae	*Erythrina variegata* L.	Baadisha
49.	Papilionaceae	*Pueraria tuberosa* DC.	*Naelagum madi*
50.	Poaceae	*Dendrocalamus strictus* (Roxb.) Nees	*Veduru*
51.	Portulacaceae	*Portulaca oleracea* L.	*Paayili kura*
52.	Portulacaceae	*Portulaca quadrifida* L.	*Sannapaayili*
53.	Rubiaceae	*Benkera malabarica* (Lam.) Tirveng.	*Tella mullu chettu*
54.	Rubiaceae	*Paederia foetida* L.	*Gabbutiga*
55.	Rutaceae	*Murraya koenigii* (L.) Spreng.	*Karivepa*
56.	Rutaceae	*Toddalia asiatica* (L.) Lam.	*Mrapagandra*
57.	Salvadoraceae	*Azima tetracantha* Lam.	*Telluppi*

58.	Sapindaceae	*Cardiospermum halicacabum* L.	*Buddalalu mu*
59.	Verbenaceae	*Clerodendrum serratum* (L.) Moon.	*Bommala marri*
60.	Verbenaceae	*Premna latifolia* Rox b.	*Nelli*
61.	Verbenaceae	*Premna tomentosa* W illd.	*Nelli*
62.	Vitaceae	*Cayratia trifolia* (L.) Domin.	*Pulla mada*

Conclusion

Now a day the population is increasing abundantly, at the same time people are going to forget their culture and traditional knowledge. This will be effects on shortage of qualitative food. Therefore, steps are needed to undertake extensive education about their importance as a nutritionally balanced food and as a direct and indirect source of income predominantly for the resource poor families. Numerous of the wild foods may not be freely accessible in future due to over-exploitation, home annihilation, habitual forest fires and incursion of strange exotic species. So, efforts must be engaged to safeguard wild vegetable plants and also the rural wisdom for a sustainable management of biodiversity.

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Nanotechnology in forestry and wood science: A view

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Introduction

Nanotechnology is defined as the manipulation of materials measuring 100nanometers or less in at least one dimension. (Bruus, 2004) Nanotechnology is expected to be a critical driver of global economic growth and development in this century. Already, this broad multi-disciplinary field is providing glimpses of exciting new capabilities, enabling materials, devices, and systems that can be examined, engineered, and fabricated at the nanoscale. (Roco, 2006).Using nanotechnology to controllably produce nanomaterials with unique properties is expected to revolutionize technology and industry. The forest products industry relies on a vast renewable resource base to manufacture a wide array of products that are indispensable to our modern society. Emerging nanotechnologies offer the potential to develop entirely new approaches for producing engineered wood and fiber-based materials. They can also enable the development of a wide range of new or enhanced wood-based materials and products that offer cost-effective substitutes for non-renewable materials used in the manufacture of metallic, plastic, or ceramic products. Nanotechnology could transform the forest products industry in virtually all aspects - ranging from production of raw materials, to new applications for composite and paper products, to new generations of functional nanoscale lignocellulosics. Research and development (R&D) in nanotechnology is critically important to the economical and sustainable production of these new generations of forest-based materials that will meet societal needs while improving forest health and contributing to the further expansion of the biomass-based economy.

Nanotechnology applications in forest products

At first glance, applications of nanotechnology in forest products might appear to be a relatively new development, but in actual fact, nanoscale materials have been used in the production of sized and coated paper for over a century. Colloidal materials which are systems consisting of a mechanical mixture of particles between 1 nm and 100 nm dispersed in a continuous medium, usually water, are commonly used in paper chemicals, as well as in paints and coatings to protect wood. The terminologies used to describe nanomaterials become important because the term nanotechnology was first coined in 1974. Nanomaterials derived from renewable biomaterials like wood, especially cellulose and lignin will undoubtedly play a large role in future nanotechnology research efforts. High profile nanotechnology applications in forest products include optically transparent cellulose nanofibre paper and optically transparent cellulose nanocomposites for flexible LED displays. Wood protection applications have been a

significant focus of nanotechnology including the utilization of nanobiocides and nanocarrier delivery systems in wood preservatives. Wood coating applications of nanotechnology are now becoming common in the consumer marketplace where coatings with improved scratch and abrasion resistance, hydrophobicity, ultraviolet light blocking and dust free surfaces are touted by commercial manufacturers.

Potential uses for nanotechnology include developing intelligent wood- and paper based products with an array of nanosensors built in to measure forces, loads, moisture levels, temperature, pressure, chemical emissions, and attack by wood decaying fungi, et cetera. Building functionality onto lignocellulosic surfaces at the nanoscale could open new opportunities for such things as pharmaceutical products, self-sterilizing surfaces, and electronic lignocellulosic devices. Use of nanodimensional building blocks will enable the assembly of functional materials and substrates with substantially higher strength properties, which will allow the production of lighter-weight products from less material and with less energy requirements. Significant improvements in surface properties and functionality will be possible, making existing products much more effective and enabling the development of many more new products. Nanotechnology can be used to improve processing of wood based materials into a myriad of paper and wood products by improving water removal and eliminating rewetting; reducing energy usage in drying; and tagging fibres, flakes,and particles to allow customized property enhancement in processing.

Many challenges stand in the way of exploiting the potential benefits of nanotechnology in the forest products industry and much research will be needed to move forward in this arena. Researchers will need to address technical challenges such as the lack of fundamental understanding of lignocellulosic material formation at the nanoscale and the absence of adequate technology for measuring and characterizing these materials at the nanoscale. Participants in this effort will need to come from not only academia but from industry and government as well; they will need to come together to form an infrastructure and move forward as a cohesive unit working simultaneously towards a single goal—the advancement of nanotechnology into the forest products industry. Advancing the nanotechnology research agenda efficiently and effectively will require gaining consensus on research needs and priorities among the forest products industry, universities with forest products research and education departments and programs, technology developers and suppliers, research institutes and laboratories serving the forest products industry, and mission oriented federal agencies with supportive goals, such as the National Science Foundation, the U.S. Department of Agriculture (USDA). In addition, the forest products sector can take advantage of the linkages it has with research communities across the globe. As the industry's operation and markets become more and more global in nature, international cooperation and collaboration is imperative. Increased cooperation must also occur between the forest products and nanotechnology research communities, the federal departments and agencies with ongoing programs in nanotechnology R&D, and the National Nanotechnology Initiative (NNI). Linkages between the

forest products sector research communities and the NNI umbrella centers and user facilities (such as those sponsored by the National ScienceFoundation, DOE, and National Institutes of Health) are critical to capturing synergies, enhancingaccomplishments, and avoiding needless duplication of facilities and other resources.(Hyung, *et al*., 2007)

This can be grouped into two aspects (Laks and Heiden, 2004)

- **Nanotechnology in Wood Science**
- **Wood Science to Nanotechnology**

Nanotechnology in Wood Science

Nanotechnological Developments in Pulp and Paper

Nanotechnology may have an unforeseen impact on forest-based paper industry. Many novel materials have been developed and fundamental studies have been carried out in different areas. The examples on nanomaterials and nanostructures of interest or potential in the forest products sector are given below:

- Monolayers or multilayers by selective adsorption of polymers and biopolymers. Exfoliated clays, such as montmorillonite and hectorite for coating and barrier films
- Engineered surfaces with tailored properties by the use of enzymes for selective removal of fiber constituents, such as hemicelluloses or chemo-enzymatic modification
- Topochemical modification by surface selective chemical and physical reactions
- Micro and mesopores in wood and pulp fiber cell walls
- Isolated cellulose fibrils and fibril aggregates, such as micro fibrillated cellulose (MFC), microcrystalline cellulose (MCC) and cellulose whiskers
- Inorganic nanoparticles and colloids, and organic nanoparticles, such as dendrimers
- Nanoscale pores in paper coatings three types of nano cellulosic materials have been investigated in recent decades. The first is micro fibrillated cellulose, which is prepared by mechanical processes that involve very high shear forces to defibrillate cellulose fibres, the second – cellulose nanocrystals, which are prepared by the acid hydrolysis of cellulose fibres, followed by mechanical action, and the third – nanocomposites, which may be the combination of first and second types of nanocellulosic materials, along with polymers or other matrices.

Microfibrilated/microcrystalline cellulose

The fiber wall thickness is roughly between 1and 5 μm. The fiber wall is composed of defined layers, including the primary wall (P) and several secondary wall layers (S1, S2 and S3) each of these layers is characterized by a specific arrangement of fibrils. Chemical pulp fibres have a surface, which is characterized by a particular pattern created by wrinkles and micro fibrils in the outer layers of the fiber wall structure. The micro fibrils are generally 2-10 nm thick fibrous cellulose structures. The diameter of micro fibrils may vary depending upon the origin. In wood, the lateral dimension for micro fibrils is around 3-5 nm. “Nanofibrils” and “nano fiber” are also used as synonyms for “micro fibril”. Micro fibrils are agglomerates of elementary fibrils and always have diameters which are multiples of 3.5 nm. Micro fibrillated cellulose (MFC) was introduced in 1983.

The MFC could be as small as 3-10 nm in thickness with typically a broad range of 20-40 nm, since it consists of aggregates of cellulose micro fibrils. Researchers have used different terminology for describing MFC. Those mainly include microfibril, microfibril aggregates, microfibrillar cellulose, nanofibrils, and nano fiber and nanofibrillar cellulose. The acid hydrolysis of cellulose micro fibrils followed by sonication gives a rod-like material with a relatively low aspect ratio referred to as cellulose whiskers. The typical diameter and length distribution of cellulose whiskers is around 2-20 and 100-600 nm, respectively. Other terms used for cellulose whiskers include nanowhiskers, nanorods and rod-like cellulose crystals. Due to the near perfect crystalline arrangement of cellulose whiskers, this form of nanocellulose has a high modulus and therefore significant potential as a reinforcing material. The microcrystalline cellulose (MCC) is formed through strong hydrogen bonding among individual cellulose crystals/whiskers, which promotes reaggregation during spray-drying procedures. Their length is generally greater than 1 μm. MCC is a commercially available material widely used as a rheology control agent and as a binder in the pharmaceutical industry. The production of MFC into nanoscale elements requires intensive mechanical treatment. However, depending upon the raw material and the degree of processing, chemical treatment may be applied prior to mechanical fibrillation. The enzymatic pre-treatment prior to mechanical action has also been tried in the literature, which has shown reduction in energy demand. Siro and Plackett have reviewed the production mechanisms and properties of MFC and reported the following routes of treatments for the production of MFC

Mechanical

1. Refining and high-pressure homogenization
2. Cryocrushing
3. Grinding

Pre-treatment

1. Alkaline pre-treatment
2. Oxidative pre-treatment
3. Enzymatic pre-treatment

In general terms, the production of homogeneous fibril qualities may require major costs, including costs related to pre-treatments and energy consumption during production. The less energy is utilized, the less is the fibrillation of cellulose fibres and the less the amount of produced nanofibrils. Conventional fibrillation (e.g. homogenization without pre-treatment) produces a material that is inhomogeneous and may contain a major fraction of poorly fibrillated fibres and fines. MFC *per se* is not necessarily a nanomaterial, but contains nanostructures, *i.e*. nanofibrils.

Polymer-nanoclay composites

This is a new technology to produce paper bags equivalent to the polybags but which can degrade easily. The thickness of nanoclay in the composite is about 1nm. This barrier coating is applied in food containers and paper used in packing.

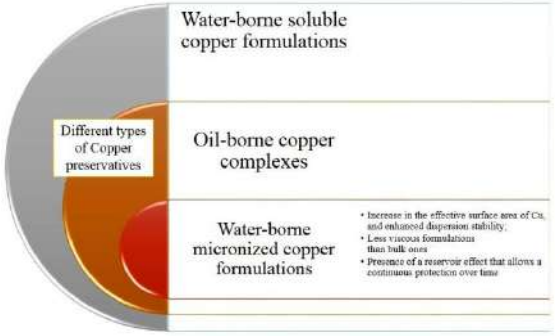
Laminates/coatings

Nanocomposites laminates are a promising application that can be applied to forestry. Sealants, coatings, and laminates are currently being used to preserve and treat wood (Green*et al.*, 2007). These preservative products can be modified at the molecular level to improve durability and moisture, decay, and fire resistance (Dorau*et al*., 2004). With nanotechnology, it is possible to create a wood-based

product that has been altered at the molecular level.

Wood preservative treatment

Treated wood products include Lumber, decking, posts, poles, stakes, pickets, landscape timbers is not new technology but the employment of nanoparticles is a new method. The need characteristics are toxicity towards wood destroying organisms, permanence in treated wood. i.e. Non-leachable, ability to penetrate deeply into the wood, freedom from any unwanted effects on the wood, non corrosive to metals, without harmful effects on the environment and should be affordable. A new copper preservative consisting of copper carbonates or oxide micro and nano particles was launched in 2006.The preservative has now captured-75-90% of the market for the copper-based wood preservative because it shows less leaching of copper, reduced corrosion of metal fixings, and lower levels of copper are needed to treat wood (least costly). (TAPPI, 2005)



Performance of nano copper preservative

The new particulate copper preservatives were approved for the use because they contained biocides that were used in preservatives but they are considered micronised rather than as nano materials. This is technology when applied it both useful in terms of economy as well as ecofriendly. (Refer Plate 1)

Wood science contribution to nanotechnology

Nanocrystals

Cellulose nanocrystals or cellulose whiskers are useful when incorporated into a polysulfone polymer membrane. A study conducted by Noorani et al. (2007) indicates that adding cellulose nanocrystals increases the tensile modulus and permeability of a polysulfone composite. This is beneficial for fabrication of nanocomposite membrane used in bio-separation devices.

Lignocellulose

Lignocellulosic material, with a nanofrillar structure, is produced from renewable forest resources and can function in a wide range of commercial products. For example, lignocellulose can be used to remove phosphorous in point and nonpoint source pollution in water (Bottiglieri,2006a). This is significant for the forest industry because it could be a larger provider of lignocellulose for pollution removal. Current water phosphorous treatment systems are not efficient. Therefore, Bottiglieri (2006b) conducted research on the lignocellulose-based anion removal media (LAM). They studied how it could be applied to adsorb phosphorous at various concentrations from polluted water bodies. Results demonstrated that LAM is significantly more efficient at removing phosphorous than the current most efficient phosphorous-absorbing media. Additionally, economic studies suggest that LAM is a very inexpensive means of phosphorous removal from water.

Future Key Themes in which Research has to be developed are

Cellulose nano building blocks

Nanofibrillar cellulose

Water / cellulose interface

Dynamic Dewetting or Quick Removal of water

Barrier coatings

Water, Oil, Vapor, Oases, Breathable, Weathering, Fire resistance

Self assembly

Nanofibrils, Nanocomposites and minerals.

Research and development

Develop new fibre-based products that take advantage of the special optical and photonic properties of nanomaterials and that enable manufacturers to increase opacity and light barrier properties of paper and paperboard, Utilize new methods for holographic imagery and graphics on paper surfaces, Employ novel optical effects on paper surfaces and in paper webs.

Make paper and paperboard products with 20-40% less fibres by significantly increasing strength of the fibres substrate thereby enabling substrate, producers to exploit the strength improvement in grade-specific ways, including: Reducing basis weight, Using significantly more recycled fibres and fibres of inferior quality, Using inexpensive fillers,

Modifications for energy efficiency Process related

Low temperature nano-catalysis with nanomaterials in pulping and other chemical reactions with wood and fibre, Nanoscale mixing of chemicals with fibre, Water removal in pressing and drying, Structural materials with lower corrosion rates, Nano pores in felts for water removal, Low corrosion materials

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Biotechnology for sustainable agriculture

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Introduction

Sustainable agriculture is a term that has been used to denote a more environmentally sound and socially responsible system of agricultural production. Although there are literally hundreds of definitions of sustainable agriculture, one of the more widely accepted definitions, developed by the US Department of Agriculture (USDA), is 'an integrated system of plant and animal production practices having a site-specific application that will, over the long-term satisfy human food and fiber needs, enhance environmental quality and the natural resource base upon which the agricultural economy depends, make the most efficient use of nonrenewable resources and integrate, where appropriate, natural biological cycles and controls, sustain the economic viability of farm operations and enhance the quality of life for farmers and society as a whole.

It is important to note that this definition encompasses the three dimensions most closely associated with sustainable agriculture – the economic dimension, the environmental dimension and the social and community dimension. A truly sustainable agriculture is one that is economically profitable for farmers, preserves and enhances environmental quality, contributes to the well-being of farm households and nurtures local community development.

Importance of agricultural biotechnology

The continuing increase in the world's population, coupled with the limitations in the world's supply of natural resources and widespread degeneration of the environment (climate chage), presenting a major challenge to agricultural scientists today. As per the estimation, food demand is set to double in the very near future and advances in agriculture are critical if we are to reduce hunger and promote growth and development in a socially acceptable and environmentally sustainable way.

Conventional plant breeding (viz. selection/ hybridization) has been the method used to develop new varieties of crops for hundreds of years. However, these methods can no longer sustain the global demand with the increasing population, decline in agricultural. Although, an extremely important tool, conventional plant breeding also has its limitations. First, breeding can only be done between two plants that can sexually mate with each other. This limits the new traits that can be added to those that already exist in that species. Second, when plants are crossed, many traits are transferred along with the trait of interest including traits with undesirable effects on yield potential.

Biotechnology is an option for breeders to overcome from these problems. Agricultural biotechnology includes a range of tools that scientists employ to understand and manipulate the genetic make-up of organisms for use in the production or processing of agricultural products. Not only can this tool be used to improve agricultural

productivity, but also to contribute towards reductions in the environmental impact of farming.

Contribution of biotechnology for sustainable agriculture

Micro-propagation

Micro-propagation is a tissue culture method developed for the production of disease-free, high quality planting material and for rapid production of many uniform plants. Through micro-propagation, it is now possible to provide clean and uniform planting materials in plantations – oil palm, plantain, pine, banana, abaca, date, rubber tree; field crops – eggplant, jojoba, pineapple, tomato; root crops – cassava, yam, sweet potato; and many ornamental plants such as orchids and anthuriums. Micro-propagated plants were found to establish more quickly, grow more vigorously and taller, have a shorter and more uniform production cycle, and produce higher yields than conventional propagules.

Molecular breeding and marker-assisted selection

The process of developing new crop varieties requires many steps and can take 10 to 14 years depending on the crop. Now, however, applications of agricultural biotechnology have considerably shortened the time it takes to bring them to market. One of the tools, which make it easier and faster for scientists to select plant traits is called marker assisted selection (MAS).

Traditionally, plant breeders have selected plants based on their visible or measurable traits, called the phenotype. But, this process can be difficult, slow, influenced by the environment, and costly – not only in the development itself, but also for the economy, as farmers suffer crop losses. As a shortcut, plant breeders now use molecular marker-assisted selection.

This technique is being used in the efficient introgression of important genes into various crops including bacterial blight resistance in rice, increased beta carotene content in rice, cassava, and banana, and submergence tolerance in rice, to name a few .(Eg. 'Swarna sub-1' a submergence tolerant version of 'Swarna' a mega-rice variety grown in large tract of eastern India was developed in record time of 4 years using MAS which was never possible with traditional breeding methods. Swarna-Sub1 is almost identical to its counterpart 'Swarna' in terms of grain yield and grain quality but it has an added advantage—it can survive full submergence for more than 2 weeks. Thus preventing the losses caused by flash floods which is very common in this area.

Genetic engineering/recombinant DNA technology and GM crops

Much has been said about potential risks of genetic engineering technology, but so far there is little evidence from scientific studies that these risks are real. Transgenic organisms can offer a range of benefits above and beyond those that emerged from traditional methodologies.

Few examples of benefits resulting from applying currently available genetic engineering techniques to agricultural biotechnology:

Enhanced crop protection

Approximately 42% of crop productivity is lost to competition with weeds and to pests and pathogens. Crops such as corn, cotton, and potato have been successfully

transformed through genetic engineering to make a protein that kills certain insects when they feed on the plants. USDA's data showed that there is continuous increase in the areas of transgenic crops coupled with decrease in the use of Insecticide/pesticide and herbicide.

Improved nutritional value

Genetic engineering has allowed new options for improving the nutritional value, flavor, and texture of foods. Transgenic crops in development include soybeans with higher protein content, potatoes with more nutritionally available starch and an improved amino acid content, beans with more essential amino acids, and rice with the ability produce beta-carotene, a precursor of vitamin A, to help to prevent blindness in people who have nutritionally inadequate diets.

Fresher produce

Genetic engineering can result in improved keeping properties to make transport of fresh produce easier, giving consumers access to nutritionally valuable whole foods and preventing decay, damage, and loss of nutrients.

Environmental benefits

When genetic engineering results in reduced pesticide dependence, we have less pesticide residues on foods, we reduce pesticide leaching into groundwater, and we minimize farm worker exposure to hazardous products. With Bt cotton's resistance to three major pests (Boll worm complex), the transgenic variety now popular among farmers in world over and has thereby reduced total world insecticide use by about 15 percent! Also, according to the U.S. Food and Drug Administration (FDA), increases in adoption of herbicide-tolerant soybeans were associated with small increases in yields and variable profits but significant decreases in herbicide use.

To date, commercial GM crops have delivered benefits in crop protection, but there are also a number of products in the pipeline which will make more direct contributions to food quality, clean environment, pharmaceutical production, and livestock feeds. Examples of these products include: rice with higher levels of iron and beta carotene; long life banana that ripens faster on the tree and can therefore be harvested earlier; maize with improved feed value; delayed ripening papaya; papaya ring spot virus resistant papaya; tomatoes with high levels of flavonols, which are powerful antioxidants; drought tolerant maize and wheat; maize with improved phosphorus availability; arsenic-tolerant plants; insect resistant eggplant and rice; edible vaccines from fruit and vegetables; low lignin trees for paper making among others.

Role of biotechnology in exploring and protecting agricultural and forest genetic resources

Well-informed sampling strategies for germplasm material destined for ex situ conservation and designation of priority sites (i.e. identifying specific areas with desirable genetic diversity) for in situ conservation are both crucial for successful conservation efforts. In turn, defining strategies is dependent on knowledge of location, distribution and extent of genetic diversity. Molecular characterization, by itself or in conjunction with other data (phenotypic traits or geo-referenced data), provides reliable information for assessing,

among other factors, the amount of genetic diversity, the structure of diversity in samples and populations, rates of genetic divergence among populations and the distribution of diversity in populations found in different locations.

Molecular characterization also helps determine the breeding behavior of species, individual reproductive success and the existence of gene flow, that is, the movement of alleles within and between populations of the same or related species, and its consequences. Molecular data improve or even allow the elucidation of phylogeny, and provide the basic knowledge for understanding taxonomy, domestication and evolution. As a result, information from molecular markers or DNA sequences offers a good basis for better conservation approaches.

Conclusions

Sustainable development has become a priority for the world's policy makers. The main sector for biotechnologically supported sustainable development is almost certainly agriculture i.e food production. Important advances have been made in developing herbicide- and pest-resistant transgenic plants but other developments of at least equal importance for the future world food supply, such as nitrogen fixation and resistance to environmental stresses, are still behind. More concentrated work is needed on tolerance to abiotic stresses (salinity, drought, cold). The same applies to animal breeding, where qualitative improvement is still in its infancy. Undoubtly, Biotechnology will hold the great promise to transforms agriculture from a resource-based to a science-based industry and can generate social, economic and environmental benefits if specifically targeted at specific needs of resource-poor farmers.

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अचानकमार-अमरकंटक बायोस्फियर रिजर्व में पाये जाने वाले पतंगे

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पतंगे रात्रिचर रंगबिरंगे आकर्षक जंतु होते हैं । तितलियाँ और पतंगे दोनों 'लेपीडोप्टेरा' वर्ग के प्राणी होते हैं । पतंगों की १.६ लाख से ज़्यादा क़िस्में ज्ञात हैं, जो तितलियों की क़िस्मों से लगभग १० गुना हैं । वैज्ञानिकों ने पतंगों और तितलियों को अलग बतलाने के लिए ठोस अंतर समझने का प्रयत्न किया है लेकिन यह सम्भव नहीं हो पाया है । अंत में यह बात स्पष्ट हुई है कि तितलियाँ वास्तव में रंग-बिरंगे पतंगों का एक वर्ग है जो भिन्न नज़र आने की वजह से एक अलग श्रेणी समझी जाने लगी हैं । अधिकतर पतंगे रात को सक्रीय होते हैं, हालाँकि दिन में सक्रीय पतंगों की भी कई जातियाँ हैं । ये जमीन की सतह के समानान्तर पंख फैलाकर बैठते हैं । ये सामान्यतः दिन में ये तने तथा पत्तियों, पेड़ों की शाखाओंए कमरों तथा छत में छिपकर बैठते हैं तथा रात्रि में जहां प्रकाश होता है वहां पर मिलते हैं। इन्हे एकत्रित करने कि लिये समय -समय पर विभिन्न स्थानों का सर्वे कर लाइटट्रैप की मदद से इन्हे पकड़ा जाता है । एकत्रित नमूनों को प्ररक्षित करके रखा जाता है ।

1. एक्टियास सेलेनी (मूनमॉथ) (हबनर)

फैमिली – सैटरनिडी, स्थिति - सामान्य

विवरण- इसके पंखों की चौड़ाई लगभग ♂ 132 - 166 तथा ♀ 140 - 182 मि. मी. तक होती है । सिर, वक्ष तथा उदर श्वेत रंग का होता है तथा पंखों

चित्र 1. *एक्टियास सेलेनी* (मूनमॉथ)

का रंग हल्का हरा होता है । आगे के पंखों का ऊपरी किनारा गहरे गुलाबी रंग का होता है तथा पंखों के बीच में हल्के पीले रंग की तिरछी खड़ी लाइन होती है । पंख के सेल वाले भाग पर गहरे लाल भूरे रंग का एक गोल निशान होता है तथा पीछे वाला पंख आगे के पंख के समान ही होता है । यह रोशनी की तरफ आकर्षित होती है तथा सामान्य तौर पर फलदार वृक्षों के ऊपर उड़ती पायी जाती है । (चित्र-1)

2. एगाथोडिस ओस्टेन्टेलिस (हबनर)

फैमिली - पायरालिडी

स्थिति - सामान्य

विवरण- इसके पंखों की लम्बाई 26 से 40

मि. मी. तक होती है। यह हल्का पीलापन लिए हुए हल्के गुलाबी रंग का होता है। आगे वाले पंख में ऊपरी किनारा सफेद होता है तथा बीच में एक गुलाबी रंग की तिरछी खड़ी मोटी पट्टी होती है तथा पंख के बाहरी किनारे के पास एक सफेद लाइन से घिरी हुई अर्द्धवृत्तीय आकृति होती है तथा पिछले पंख हल्के पीले रंग के होते हैं। यह भारत में

सभी जगह पाया जाता है। (चित्र-2)

3. एन्थीरा पेफीया (रेशम कीट) (लिन)

फैमिली – सैटरनिडी, स्थिति - सामान्य

चित्र 3 (अ) *एन्थीरा पेफीया* (रेशम कीट) ♀

विवरण- इसके पंखों की चौड़ाई लगभग ♂ 140 - 174 तथा ♀ 150 - 190 मि. मी. तक होती है। यह हल्के पीले भूरे या हल्के लाल भूरे रंग का होता है। इसके पंख में बीच में एक गोल बड़ा पारदर्शी निशान पाया जाता है जो कि हल्की काली व गुलाबी लाइन से घिरा होता है। पंखों के मध्य से बाहर की ओर खड़ी तिरछी गुलाबी रंग की लाइन

चित्र 3 (ब) एन्थीरा *पेफीया* (रेशम कीट) ♂

होती है। (चित्र-3)

4. थरेट्रो ऑलडेन्लेन्डी (फेब)

फैमिली - स्फिन्जिडी

स्थिति - सामान्य

विवरण- इसके पंखों की चौड़ाई लगभग 80 मि.मी. तक होती है। यह स्लेटी भूरे रंग का होता है। उदर के ऊपरी ओर सिल्वर रंग की लाइन होती है तथा किनारे हल्का पीला रंग होता है और अगले पंखों पर भी तिरछी लाइनें होती हैं। पिछले पंखों में

चित्र 4. *थरेट्रो ऑलडेन्लेन्डी*

बाहरी किनारे का भाग हल्का पीला होता है। (चित्र-4)

5. एपिसपेरिस वेरियेलिस (वाकर)

फैमिली - नॉक्टिडी

स्थिति - सामान्य

चित्र 5. *एपिसपेरिस वेरियेलिस*

विवरण

इसके पंखों की चौड़ाई लगभग 50 मि.मी. तक होती है । यह हल्के लाल भूरे रंग का होता है । अगले पंखों में सबबेसल तथा एन्‌अीमीडियल सफेद लाइन होती है । इसके बाद हल्के पीले तथा सफेद रंग के निशान होते हैं तथा बीच में एक गोलाकार घूमी हुई लाइन होती है । एक लहरदार हल्की लाइन ऊपरी किनारे के सफेद निशान तक जाती है । बाहरी किनारे पर सफेद तथा पीले निशान होते हैं । (चित्र-5)

6. साइलोग्रामा मेनीफ्रान (क्रेम)

चित्र 6. *साइलोग्रामा मेनीफ्रान*

फैमिली - स्फिन्जिडी

स्थिति - सामान्य

विवरण

इसके पंखों की चौड़ाई लगभग 80 -122 मि. मी. तक होती है । यह स्लेटी रंग का होता है ।

वक्ष पर कुछ गहरी भूरी लाइनें होती हैं उदर के ऊपर एक गहरी लाइन होती है । अगले पंखों पर गहरी आड़ी-तिरछी लहरदार लाइनें होती हैं । पिछले पंख भूरे रंग के होते हैं । (चित्र-6)

7. यूटेक्टोना मेकेरेलिस वाक

फैमिली - पायरालिडी

स्थिति - सामान्य

चित्र 7. *यूटेक्टोना मेकेरेलिस*

विवरण

इसके पंखों की चौड़ाई लगभग 22 -24 मि.मी. तक होती है । यह हल्के पीले रंग का होता है । पंखों पर हल्की तिरछी लहरदार खड़ी लाइनें होती हैं । बाहरी ओर की लाइन बाहर की ओर झुकी होती है तथा दोनों पंखों में किनारे पर गहरी लाइन होती है । यह सागौन के वनों में पत्तियों के पीछे छिपा हुआ रहता है । (चित्र-7)

8. जायल्यूटस स्टिक्स क्रेम

फैमिली - कोसिडी

स्थिति - सामान्य

विवरण

इसके पंखों की चौड़ाई लगभग ♂ 110 - 130 तथा ♀ 170 - 188 मि.मी. तक होती है । यह

काले सफेद रंग का होता है। सिर, वक्ष तथा उदर में काले घने रोयें होते हैं। उदर के किनारे नीचे की ओर प्रत्येक खण्ड में सफेद रोये भी होते हैं। अग्र पंख काले व सफेद रोयदार तथा जालीनुमा होते हैं। ऊपरी किनारे पर तथा बीच में कुछ काले निशान

होते हैं। पिछले पंख भी जालीदार घुंधले काले रंग के होते हैं। (चित्र-8)

9. एसोटा कैरिकी, फैब (हिप्सा *एल्सीफ्रान)*

फैमिली - हिप्सिडी

स्थिति - सामान्य

विवरण

इसके पंखों की चौड़ाई लगभग ♂ 62 - 67 तथा ♀ 72 - 76 मि. मी. तक होती है। सिर, वक्ष तथा

चित्र 9. *एसोटा कैरिकी*

उदर पीले नारंगी रंग के होते हैं। अगले पंख स्लेटी भूरे रंग के होते हैं। पंख के बीच में एक नारंगी निशान तथा तीन छोटे काले निशान होते हैं तथा बीच में एक सफेद आड़ी लाइन होती है।

पिछले पंख पीले रंग के होते हैं। तीन छोटे काले निशान होते हैं तथा बाहरी किनारे पर काली लाइन होती है। (चित्र-9)

10. सेरुरा लिटराटा वाक

फैमिली - नोटोडोन्टिडी

स्थिति - सामान्य

चित्र 10. *सेरुरा लिटराटा*

विवरण

इसके पंखों की चौड़ाई लगभग ♂ 40 - 70 तथा ♀ 62 - 90 मि. मी. तक होती है। यह सफेद रंग का होता है। सिर, वक्ष तथा उदर में कुछ काले निशान होते हैं। अगले पंख में बेसल एरिया के पास दो लहरदार तथा एक बीच में लहरदार काली लाइन होती है। मध्य में कुछ काले निशान होते हैं। एक अध्याधिक लहरदार लाइन होती है। एक मध्य लाइन मुड़कर एक वलय बनाती है। तीन लाइनें बाहरी किनारे की ओर होती हैं तथा किनारे पर काले बिन्दुओं की श्रेणी होती है। पिछले पंख हल्के भूरे रंग के होते हैं। (चित्र-10)

11. डायफेनिया (ग्लाइफोडस) इंडिका सांड

फैमिली - पायरालिडी

स्थिति - सामान्य

चित्र 11.डायफेनिया (ग्लाइफोडस) *इंडिका*

विवरण

इसके पंखों की चौड़ाई लगभग 24 - 28 मि. मी. तक होती है । सिर तथा वक्ष भूरे रंग का होता है तथा उदर सफेद होता है । उदर के आखिरी दो खण्ड काले होते हैं तथा आखिरी खण्ड में काले घने रोमों का गुच्छा होता है। अगले पंखों में ऊपरी किनारा काला होता है तथा उसके नीचे एक पारदर्शी त्रिकोणनुमा आकृति होती है। पिछले पंख भी सफेद पारदर्शी होते हैं तथा निचला बाहरी किनारे पर काले रंग की पट्टी होती है । (चित्र-11)

12.स्पोलाइडिया (हाइमेनिया) रिकरवेलिस फैब

फैमिली - पायरालिडी

स्थिति - सामान्य

चित्र 12. *स्पोलाइडिया* (हाइमेनिया) *रिकरवेलिस*

विवरण

इसके पंखों की चौड़ाई लगभग 24 मि. मी. तक होती है । यह कत्थे भूरे रंग का होता है । अगले पंख में मध्य में एक काले रंग से घिरा सफेद लम्बा निशान होता है । उसके बाद एक और सफेद निशान होता है इसी तरह पिछले पंख में भी थोड़ा सा चौड़ा सफेद निशान होता है जो कि निचले सिरे पर सकरा होता है । (चित्र-12)

13.हाइपोसिंड्रा टलाका वाक

फैमिली - जियोमेट्रिडी

स्थिति - सामान्य

चित्र 13. *हाइपोसिंड्रा टलाका*

विवरण

इसके पंखों की चौड़ाई लगभग ♂ 44, तथा ♀ 54 - 60 मि. मी. तक होती है । यह स्लेटी भूरे रंग का होता है । अगले पंख का बाहरी ऊपरी किनारा कटावयुक्त होता है । अगले व पिछले दोनों पंखों में दांतेदार हल्की धुंधली दो-दो लाइने होती हैं । (चित्र-13)

14.मरुम्बा (पोलीप्टाइकस) डायरस वाक

फैमिली - स्फिंजिडी

स्थिति - सामान्य

विवरण

इसके पंखों की चौड़ाई लगभग 94 -114 मि. मी. तक होती है। यह हल्के भूरे रंग का होता है। इसके अगले पंखों में कई तिरछी खड़ी लाइने होती हैं। पंख के बाहरी किनारे की ओर वाली

चित्र 14. *मरुम्बा* (पोलीप्टाइकस) *डायरस*

लाइन अत्यधिक मुड़ी हुई तथा अन्दर की ओर झुककर एक लाल निशान को घेरती हुई जुड़ी रहती है। पंख का बाहरी किनारा लहरदार होता है। पिछले पंख लाल भूरे होते हैं तथा अन्दर की ओर एक लाल भूरा निशान होता है। (चित्र-14)

15. थेरेट्रा एलेक्टो एलेक्टो लिन

फैमिली - स्फिंजिडी

स्थिति - सामान्य

चित्र 15. *थेरेट्रा एलेक्टो एलेक्टो*

विवरण

इसके पंखों की चौड़ाई लगभग ♂ 90, तथा ♀ 106 मि. मी. तक होती है। सिर, वक्ष तथा उदर हल्के भूरे रंग के होते हैं उदर के पार्ष्व भाग में पहले खण्ड के पास एक बड़ा काला निशान होता है। अगले पंख हल्के भूरे रंग के होते हैं मध्य के पास एक काला बिन्दुनुमा निशान होता है। छः तिरछी खड़ी घुंधली लाइनें होती हैं जो कि पंख के ऊपरी किनारे से शुरु होकर निचले किनारे के मध्य तक पंहुचती हैं। पिछले पंख गुलाबी रंग के होते हैं तथा अन्दर की ओर काला बड़ा निशान होता है। (चित्र-15)

ड्रैगनफ्लाई', जिन्हें 'चिऊरा' तथा 'व्याध पतंगा' के नाम से भी जाना जाता है, वास्तव में इनका अस्तित्व धरती पर 30 करोड़ साल से भी ज्यादा पुराना माना जाता है और ये विश्व में लगभग हर जगह पाए जाते हैं। गोवा के एक वन्यजीव अभयारण्य में शोधकर्ताओं ने ड्रैगनफ्लाई नामक पतंगे की नई प्रजाति की खोज की है। भारतीय प्राणी वैज्ञानिक सर्वेक्षण, कोलकाता के वैज्ञानिक ने दक्षिणी गोवा स्थित कोल्लम के भगवान महावीर वन्यजीवन अभयारण्य में इडियोनिक्स गोमेंटाकेनसिस नामक प्रजाति की पहचान की है। यह प्रजाति सदाबहार वनों में पाई जाती है। इस वंश की अधिकतर प्रजातियां दक्षिणी भारत से हैं जबकि गोवा से ऐसी दो प्रजातियां हैं। इस वर्ग के पतंगे अपने जीवनचक्र को पूरा करने के लिए पानी पर निर्भर होते हैं। इस तरह पानी की गुणवत्ता प्रजातियों की संरचना को परिभाषित करती है। ड्रैगनफ्लाई की सबसे बड़ी खासियत यह है कि यह अपनी उड़ान की दिशा एकाएक बदल सकता है, सामने से आती किसी भी वस्तु से दुबककर बच सकता है और एक सैकेंड के भी सौवें हिस्से में उड़ान भर सकता है अथवा उड़ान समाप्त कर सकता है। पतंगे मनुष्यों को कोई नुकसान नहीं पहुंचाते। ये कीटों तथा छोटी मछलियों का भोजन करते हैं।

Know your biodiversity

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Meconopsis aculeata

Meconopsis aculeata is a medicinal herb endemic to Himalaya. This plant is categorized as endangered in International Union of Conservation of Nature (IUCN) Red List. It belongs to family Papavaraceae. The generic name '*Meconopsis*' is derived from Greek word 'Mecon' means Poppy and 'opsis' means resemblance. The species name '*aculeata*' means bearing a prickle. It is known as 'Queen of Himalayan flowers' because it gorgeously decorates the alpine meadows and rock debris with its beautiful blue and purple flowers.

The distribution of Blue Poppy is in India, Bhutan, Nepal, China and Pakistan. In India it is found in Himachal Pradesh, Jammu & Kashmir, Uttarakhand and Uttar Pradesh. In Himachal Pradesh it is found in Chamba, Kangra, Kinnaur, Kullu, Lahaul-Spiti and Shimla districts at altitude of 3000-4500 m. It is commonly known as Blue Poppy and Himalayan Poppy. In Himachal Pradesh it is known as Kanada and Kanta.

It is small erect bristly perennial herb. Stem is about 40-60 cm, simple or branched at base. Leaves oblong, cordate and pinnatifid with irregularly divided segments. Leaves at the top are smaller and sessile. Flowers bisexual, blue or purple. Petals 4, rarely 6 obovate, thin and papery. Stamens many, yellow. Ovary obovoid-ellipsoid. Fruit capsular and prickly. Seeds many subreniform, oblong-ellipsoids, rugose or smooth. Flowering and fruiting period is June - September.

In Tibetan medicine whole plant is used as pain killer, tonic, renal colic and for backache. It is also used in treatment of fever, rheumatic pains, inflammations and bone related problems. Whole plant contains narcotic constituents and also used as narcotic. Roots are poisonous. Water extract of whole herb, including flowers is used to wash wounds. Paste of petals is given with milk to reduce the body pain. Flowers are frequently used to cure asthmatic problems by local people of Chamba and the Lahaul-Spiti regions of Himachal Pradesh.

In 1982 Indian Postal Department issued a postal stamp to commemorate this flower. This plant is highly valued for its medicinal properties but resulting demand of the plant as medicine has placed pressure on wild population due to overexploitation. Beside this overgrazing and avalanches are also responsible for its decline. Hence there is urgent need to conservation of *Meconopsis aculeata* through in situ and ex situ conservation.

In the colourful world of flowers, where blue does not occur frequently, the Blue

Poppy is a rare ornamental. It gorgeously decorates alpine medows and the rock debris of moraine with flowers that come in lovely shades of blue and purple, often luminescent against snowy background, and always pleasing. They are slender-pedicelled, usually 4-petalled and measure 5 to 11 cm. across. The numerous golden-yellow stamens contrast well with the blue petals. Leaves are deeply and irregularly lobed, sparsely bristly haired; lobes usually rounded-toothed and widely spaced. The prickly herbaceous perennial, of the Poppy family, has narcotic poisonous roots. It is found from Kumaon to Kashmir at elevations of 3,000 to 4,500 meters.

Passer rutilans

Passer rutilans is a small bird found in Eastern Asia and Himalayas. In India it is found in Assam, Himachal Pradesh, Kashmir, Sikkim, and Uttarakhand at altitude of 900 m to 3400 m. In the winters it migrates to lower altitudes. It belongs to family Passeriformes and family Passeridae. It is commonly known as Cinnamon, Cinnamon sparrow and Russet sparrow. *Fringilla rutilans* is synonym of *Passer rutilans.* It was first described by Dutch Zoologist Coenraad Jacob Temminck in 1835 as *Fringilla rutilans*. The generic epithet 'Passer' means small active bird and the species epithet 'rutilans' means reddish brown.

It resembles with House sparrow and generally seen in pairs or flocks in or on outskirts of villages and in forest. It is easily distinguished from it by its bright cinnamon-rufous upper plumage and yellowish under parts with black chin and throat. Beak is thick and black. Iris chestnut colour. Legs pale brown to pinkish brown. The female is duller above and with a conspicuous 'pale eyebrow'. It shows sexual dimorphism. Females have pale brown upperparts and pale grey under parts. Juveniles are similar to females.

Male shows courtship behaviors by raising his head, drooping his wings, pushing chest forward and lowering tail, when female comes near to male. Breeding period is April-August and often two successive broods are raised. It lays 4-6 eggs. Eggs are elongated oval, whitish or pale greenish-white marked with various shades of brown. Incubation period is 12-13 days. Both the sex take part in building the nest, incubating the eggs and feeding the young ones. Generally male chooses the nest site before finding a mate. The nest is made of grass, roots etc and lined with hairs and feathers. It is placed in holes and hollows in trees and dead stumps in the open forest. Sometimes nest are seen in thatch roofing of houses, abandoned houses, stone walls and electric junction boxes.

It feeds mainly on insects, grains, fruits and seeds. Isospora, Melanocanthus and Protocalliphora are the major parasites which infects the young birds. Global population of this bird species is not quantified but IUCN red list category it is given status of least concern because of its wide distribution.

The global population size has not been quantified, but the species is described as common or locally common, although

scarce in some parts of its range (Clement 1999), while national population estimates include: c.10,000-100,000 breeding pairs and c.1,000-10,000 individuals on migration in China; < c.100 breeding pairs in Taiwan; c.10,000-100,000 breeding pairs, c.1,000-10,000 individuals on migration and c.1,000-10,000 wintering individuals in Korea; c.10,000-100,000 breeding pairs, c.1,000-10,000 individuals on migration and c.1,000-10,000 wintering individuals in Japan and c.10,000-100,000 breeding pairs and c.1,000-10,000 individuals on migration in Russia (Brazil 2009).

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