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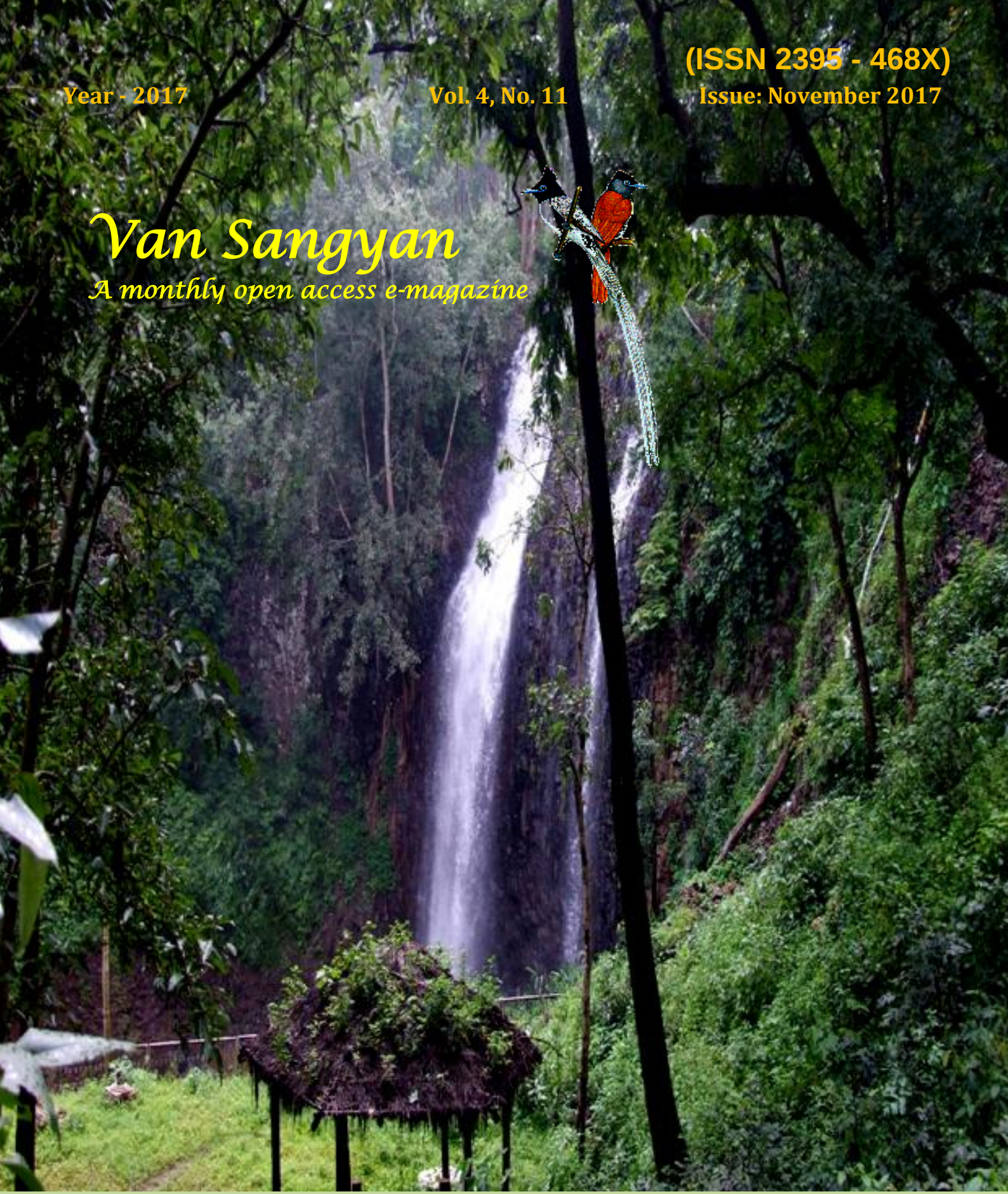

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Van Sangyan

Editorial Board

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

Macrofungi have long been investigated for various scientific purposes including their food and medicinal characteristics. Fungi, one of the most important components of the ecosystem, comprise the largest biotic community after insects and include thousands of lineages, from the mushroom-forming fungi to yeasts, rusts, smuts, mold, and other symbionts with differing phenotypic and genotypic features. Only 50% of the 1.5 million fungi present in the world have been identified and characterized thus far. Macrofungi, which are visible to the naked eye (1 cm in size), possess mature spore-bearing and morphologically distinct fruiting bodies Of the four fungal phyla recognized, macrofungi belong to the Ascomycota (AMC) and Basidiomycota (BMC). Macrofungi (also called mushrooms) are represented by 41,000 species across the globe; however, only ~2% have been reported from India, despite the fact that one-third of the total global fungal diversity exists in the tropical Indian region. Mushrooms, which naturally prefer all types of soil, grassy ground, rotten wood, leaf litter, decaying organic matter, etc., have the ability to grow in different seasons, yet all exhibit enhanced growth during the rainy season. Macrofungi are important economically due to their importance in food, medicine, bio-control, chemical, biological and other industries. Although the macrofungi are an integral part of a given ecosystem, their diversity and types are poorly studied, with a particular knowledge gap in the tropical regions including India. Furthermore, macrofungi are not only significant in the terrestrial ecosystem but also play an important role in the atmospheric biogeochemical cycles by acting as a potential source of bioaerosols, mainly as fungal spores. Fungal aerosols are portions of the fungal bodies that are small enough to become airborne and mostly involve the spores, hyphae and mycelia. Fungal spores comprise a large proportion of outdoor coarse particles (1–10 μm) released either actively or passively from their parent bodies. Ambient fungal aerosols originate mainly from the fungi growing on plant/tree surfaces or from the fungi thriving in the soil. Previous studies have reported that fungi can contribute 4–11% of the mass of fine particulate matter (PM2.5,particulate matter 2.5 μm) and 21% of the coarse particulate matter (PM10, particulate matter 10 μm). With a global emission rate of ~50 Tg yr−1, the number and mass concentrations of fungal spores in the continental boundary layer are of the order of 103 –107 m-3 and ~1 μg m-3, respectively. Interestingly, among all of the sources, nearly 34% (~17 Tg yr−1) is contributed by wet discharged macrofungal basidiospores. Thus, macrofungi also play an important role in the atmospheric system by releasing fungal spores into the air. However, this aspect of macrofungi with its link to aerobiology has been largely overlooked. For example, mycologists have focused on investigating the diversity of terrestrial macrofungi. On the other hand, the focus of aerobiologists has been mainly to characterize the types and diversity of airborne fungal spores. Fungal spores can be transported over large distances by dispersion in air. Once these spores are in contact with the proper substrate under optimal conditions (e.g., with nutrients, moist conditions under high temperature, etc.), the growth of new fungi is initiated. Because of their abundant and widespread dispersal in the atmosphere, these spores can adversely affect plants and animals,including humans. It is now widely accepted that certain fungal spores are also capable of initiating the formation of ice nuclei in deep convective clouds at relatively warmer temperatures than required for homogeneous ice nucleation, thus affecting the hydrological cycle. Therefore, considering the importance of macrofungi in the ecosystem, including their role in aerobiology, it is important to investigate their types, abundance, and diversity over various ecosystems including characterizing their sources. A large number of studies investigating the characteristics of macrofungi rely on traditional field-guide-based identifications,optical microscopy, and nutrient-specific culturing.

This issue of Van Sangyan contains an article on Diversity of macro-fungi in central India-IX: Laetiporus sulphurous. There is also useful articles viz. Aerial drones - scope and application potential in forest management, Effects of industrialization on environment, Fritillaria roylei Hook. f. in Himachal Pradesh, Importance of butterflies in ecosystem, Potential biopesticides: Ivermectin and Spinosad, Significance of wood seasoning, Adverse effect of solar radiation on environment and Biodiversity of Nardostachys jatamansi and Hemitragus jemlahicus.

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. Roychoudhury
Scientist G & Chief Editor

Contents

Diversity of macro-fungi in central India-IX: *Laetiporus sulphurous*

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Introduction

Laetiporus sulphureus is a species of bracket fungus (fungi that grow on trees). Its common names are crab-of-the-woods, sulphur polypore, sulphur shelf, and chicken-of-the-woods. Its fruit bodies grow as striking golden-yellow shelf-like structures on tree trunks and branches. Old fruit-bodies fade to pale beige or pale grey. The under surface of the fruit body is made up of tube-like pores rather than gills. It is a saprophyte and occasionally a weak parasite, causing brown cubical rot in the heartwood of trees on which it grows. Unlike many bracket fungi, it is edible when young, although adverse reactions have been reported. This macro fungus was first described as *Boletus sulphureus* by French mycologist Pierre Bulliard in 1789. It has had many synonyms and was the current name was given by William Murrill in 1920. Fruiting body sometimes grows up to 60 cm across; usually consisting of several to many individual caps arranged in a shelving formation or a rosette. Caps: 5-30 cm across and up to 20 cm deep; up to 3 cm thick; fan-shaped to semicircular or irregular; more or less planoconvex; smooth to finely wrinkle; suede-like; bright yellow to bright orange when young, frequently fading in maturity and with direct sunlight. Pore Surface: Yellow; with 2-4 circular to angular pores per mm; tubes to 5 mm deep. Flesh: Thick; soft and watery when young, becoming tough, eventually crumbling away; white to pale yellow. The cap is attached directly to the trunk of a tree and is initially knob-shaped, but soon expands to fan-shaped, typically growing in overlapping tiers. It is sulphur-yellow to bright orange in colour and has a suede-like texture. Old fruit-bodies fade to tan or whitish. Each shelve may be anywhere from 5 to 60 cm (2 to 23.5 in) in diameter and 4 cm (1.5 in) thick. The fertile surface is sulphur-yellow with small pores or tubes and has a white spore print. When fresh, the flesh is succulent and exudes a yellowish juice, but soon becomes dry and brittle. It has a strong, fungusy smell. The mushroom causes brown cubical rot on the heartwood in the roots, base and stem. At first the wood is discoloured yellowish to red. Later on it becomes reddish-brown and brittle. At the last stage the wood can be rubbed like powder between the fingers.

Some people have had gastrointestinal upset after eating this mushroom, and it should not be consumed raw. Studies have shown severe adverse reactions, including vomiting and fever, in about 10% of the population, but this is now thought to be a result of confusion with morphologically identical species such as *Laetiporus huroniensis* which grows on hemlock trees, and *L. gilbertsonii* which grows on *Eucalyptus.* The mushroom produces the *Laetiporus sulphureus* lectin (LSL) which

has haemolytic and haemagglutination activities. Haemolytic lectins are sugar-binding proteins that lyse and agglutinate cells. The haemagglutination and haemolytic activity are started by binding carbohydrates

Materials and methods

Specimens were collected from TFRI campus (N 23°05'431", E79°59'060"), Jabalpur, Madhya Pradesh. Identification of fungus was done with the help of literature (Berkeley 1851; Breitenbach and Kränzlin 1986; Burdsall Jr.et al., 2001; Kuo, 2005; Kyriakou et al., 2009; Lindner and Banik 2008; Mancheño et al., 2005; Rost, 2007; Sabaet al., 2015; Schwarze et al 2000; et al 1980; Spahr, 2009; Tarafder et al., 2017). The slides were prepared in lacto-phenol and cotton blue and observed under advance Research Microscope, make Leica, Germany and photomicrographs were taken with a digital camera attached to microscope. The specimens were deposited in the Mycology Herbarium, Tropical Forest Research Institute, Jabalpur and got accession numbers.

Results

***Laetiporus sulphureus* (Bull.) Murrill**, Annls mycol. 18(1/3): 51 (1920)

(Fomitopsidaceae, Polyporales, Incertae sedis, Agaricomycetes, Agaricomycotina, Basidiomycota)

≡*Boletus sulphureus* Bull. 1789

=*Boletus tenax* Lightf., *Fl. Scot.* 2: 1031 (1777)

=*Polyporus sulphureus* (Bull.) Fr., *Syst. mycol.* (Lundae) 1: 357 (1821)

=*Sistotrema sulphureum* (Bull.) Rebent., *Prodr. fl. neomarch.* (Berolini): 376 (1804)

=*Tyromyces sulphureus* (Bull.) Donk, *Meded. Bot. Mus. Herb. Rijks Univ. Utrecht* 9: 145 (1933)

Taxonomic description

Basidiocarps annual, laterally stipitate to sessile, single to imbricate clusters with narrow base, medium to large size. Pileus 10–13 cm long, 14–19 cm broad, 1–1.5 cm thick near the base, soft, dimidiate to semicircular, flabelliform; upper surface light yellow, brownish near bases, azonate, fading to almost with age on drying, smooth, glabrous; margin white, thick, rounded. Context 4–10 mm thick, soft fleshy and watery when fresh, soft and fragile when dry; white to light yellow. Hymenial surface sulphur yellow, when fresh, brownish yellow to dark brown on drying. Pores angular circular 1.6-2 pores per mm; tubes up to 5 mm deep, tube layer sulphur yellow when fresh, dark brown on drying; striate to slightly oblique, 1–2.5 mm long. Hyphal system dimitic; generative hyphae, hyaline, thin-walled, simple septate, with rare branching. Binding hyphae 2–7 µm wide, hyaline, non-septate, thick-walled, much branched. Basidia clavate, with basal clamp, 4-spored; sterigmata 2–4 µm long (12–20 × 2.5 – 7.5 µm. Basidiospores ovoid to ellipsoid, smooth, hyaline-light-olivaceous, moderately thick-walled, 4.5–7× 4.5–6.0 µm (Figs. 1-8). Similar sp., *Meripilus giganteus*

Distinctive features

The basidiocarp is bright yellow to orange in imbricate clusters causing heart rot. Among morphologically related taxa it differs with other taxa by its citric yellow to pale orange surface of basidiocarps and sulphur yellow pores surface. *Laetiporus* means "with bright pores" and *sulphureus* means the colour of sulphur

Specimen examined

Growing on bases of living culms or dead stumps of bamboo (*Bambusa vulgaris* var.

yellow), TFRI campus, Jabalpur, MP, 5/10/2017, R.K. Verma, Mycology Herbarium, Tropical Forest Research Institute, Jabalpur, TF 3973.

Host range

Bamboo, on living and dead oaks, wood hardwoods, *Quercus*, *Prunus*, *Pyrus*, *Populus*, *Salix*, *Robinia* and *Fagus*, *Ceratonia* and *Eucalyptus*, occasionally on conifers

Distribution

Laetiporus sulphureus is widely distributed across Europe and North America though may be restricted to east of the Rockies. It grows on dead or mature hardwoods and has been reported from a very wide range of host trees from August to October or later, sometimes as early as June. In the Mediterranean region, this species is usually found on *Ceratonia* and *Eucalyptus*. It can usually be found growing in clusters in Europe and North America (Breitenbach and Kränzlin, 1986; Burdsall Jr. et al., 2001); In India it is reported from Toglo Hills, Sikkim; Sonamarg, Kashmir (Berkeley MJ (1851c); Nadia and 24-Parganas, West Bengal (Tarafder et al., 2017).

Artificial cultivation

Compared with species such as *Agaricus bisporus* (button mushroom) and oyster mushroom, commercial cultivation of *Laetiporus* is limited. However, it can be cultivated; the most dependable and rapid production of this mushroom is cultivation of it in indoors. The mushroom may or may not require the heat and water that gilled mushrooms do, depending on the strain. The mushroom is sensitive to carbon dioxide levels and light conditions. Artificial cultivation on synthetic substrate has been achieved (Pleszczynska et al., 2013).

Economic importance

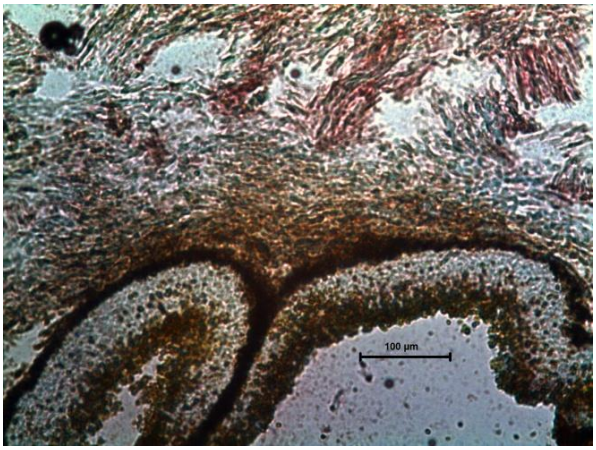
Edible, causing brown cubical rot in bamboo roots, unlike many bracket fungi, it is edible when young. Because of the taste, the mushroom has been called *chicken polypore* and *chicken-of-the-woods*. Many people think that the mushroom tastes like crab or lobster. The authors of *Mushrooms in Color* said that the mushroom tastes good sauteed in butter or prepared in a cream sauce served on toast or rice. It is highly regarded in Germany and North America. Young specimens are edible if large amounts of a clear watery liquid come out of it. The mushroom should not be eaten raw. Deer like to eat the mushroom.

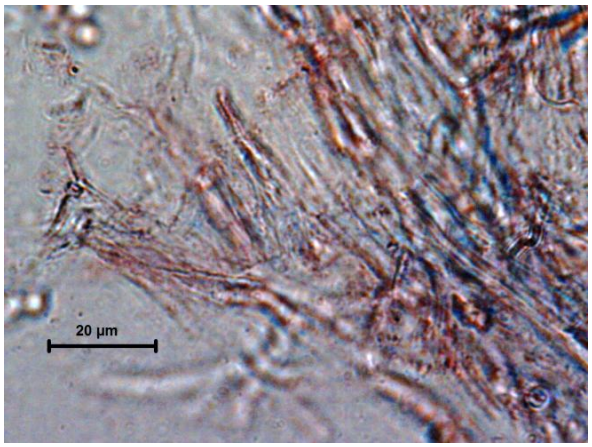
Fig. 1. *Laetiporus sulphureus*, habit, fruit body attached to living bamboo (*Bambusa vulgaris* var. yellow

Fig. 2. ***Laetiporus sulphureus*****,** fruit body attached to dead bamboo (*Bambusa vulgaris* var. yellow)

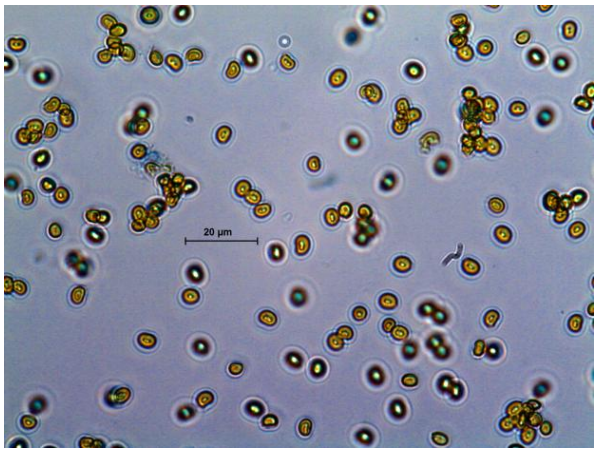
Fig. 3. ***Laetiporus sulphureus*****,** characteristic lower pore surface (sulphur yellow)

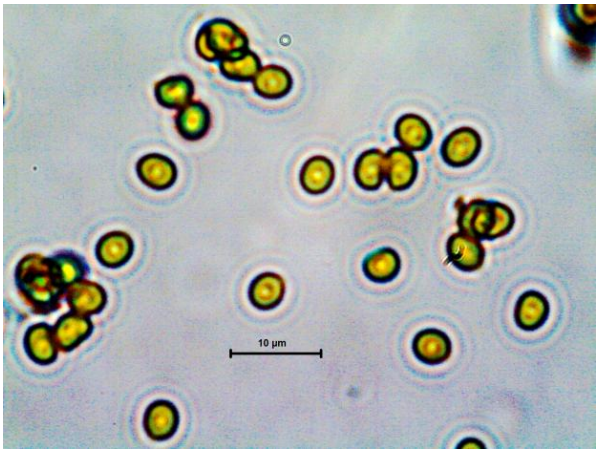
Fig. 4. ***Laetiporus sulphurous*** pore surface enlarged





Figs. 5-6. ***Laetiporus sulphureus,*** 5 cross section of pore layer, 6 hyphal system,





Figs. 7-8. ***Laetiporus sulphureus,*** basidiospores

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Aerial drones - Scope and application potential in forest management

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Abstract

India is not only one of the top ten species rich nation, but also the second largest populous country in the world. Apart from the mounting anthropogenic pressures, the vastness of our forested area, un-skilled and scarce labour force, poor infrastructure and low financial supports are setting limits to the efficientmanagement of Indian forests. Nowadays, advancements made in sophisticated sensors, aerial photogrammetry and remote sensing techniques provides us fool proof and reliable tools for monitoring, inventorying and mapping of forests. However, the conventional satellites/ crewed aircraft imageries also have limitations like higher costs, less spatial and temporal resolutions. Such shortcomings can be addressed and supplemented by employing the various shapes,size and functioned drones/ Unmanned Aerial Vehicle. These are flexible incontrol, cost effective, crews-less and capable of delivering high-resolution data at shortest time. Hence,drone remote sensing has lots of scope inforest surveying and monitoring, mapping canopy gaps, estimation of forest composition, forest ecosystemsmodelling, wildlife surveying and monitoring, forest fire monitoring, precision forestry, forest stock and health inventories.

Keywords: Drones, Unmanned Aerial Vehicle, Sensors, applications, Forest Management

Introduction

India has around 24.16% (79.42mha) under forest cover (FSI, 2015). This offers a variety of ecosystem services which are experiencing rapid negative impacts due to the economical, ecological, climatic and biophysical forces. Apart from these, vast forest area, low labour force, less infrastructure and low financial supports were also limiting the efficient administration and management of Indian forests. There is an urgent needforcollection of accurate information forthe sustainable management of forests.Nowadays the sophisticated sensors, aerial photogrammetry and remote sensing techniques provides the most advanced tool for monitoring, inventorying and mapping of forests. Other than airborne and space borne platforms, the drones or Unmanned Aerial Vehicles (UAVs) are widely used in the management of Indianforests in recent years due to their low operational costs, light weight, high intensity data collection in short time, variety of sensors, usability in inaccessible and high-risk areas. Based on the purpose at spatial and temporal scales, the selection of drone remote sensing technologycan be made. So, there is huge potential for drones in Indian forests and also it is already used. In this paper, we highlight the drone technology and its application in the forestry sector.

Drone technology

Unmanned aircrafts or ships are controlled from remote or onboard computers referred as drones. The drones were

invented and developed during the early part of 20th centuryfor various military purposes. The use of drones gradually increased after World War II (1939-1945), when unmanned aircrafts like *Ryan Firebee*was employed for reconnaissance purposes. Various shapes, sizes and capabilities of drone development during the last few decades, rapidly increased their potentials for the civilian applications. With the advent of smaller, cheaper, lighter variety of sensorshelped the emergence of modern-day drone remote sensing technology.

Application of drone remote sensing

Drones are capable to be used in a wide range of sensor varieties like visible light, near infrared (NIR), shortwave infrared (SWIR), thermal infrared (TIR), radar and lidar which also record data in multispectral or hyperspectral bands. The benefits of this technology include low operations cost, lightweight, need less time, can produce high spatial and temporal resolution images. They are also capable of flying at various heights and fly at high risk and inaccessible areas which offer a wide range of application and practices in forestry.

Forest Surveying and Monitoring

Manual surveying and mapping of the forest area involved lot of time, money, was tediousand is often plagued with logistical difficulties. Koh and Wich (2012) attempted to study the tropical forests of Indonesia using low cost (less than Rs. 7000/-) and light weight (Less than 1 Kg) conservation drones. It is equipped with*ArduPilot Mega* (open source auto pilot software), still/video camera (Pentax Optio WG 1 GPS/ GoPro HD Hero),fixed wing and powered by a 2200 mAh battery, which allowed it to fly for ~25 minutes per mission, with distance of ~15 km. By using these conservation drones, researchers were able to produce cloud free high-resolution images (5.1 cm). Hence these kind of drones, significantly reduced the time involved, cut additional manpower and was accessible to local conservation workers and researchers in the developing tropical countries.

Detection of illegal forest activities

Indian forests are still affected by a range of anthropogenic pressures like illegal felling, trespassing, land encroachment, mining, illegal drug production, poaching and illegal burning etc..So, the drones remotesensing can be an effective tool to detect illegal activites in forests areas. For example, low altitudes (80-100 m above ground) video footages obtained through conservation drones in Indonesia, one could easily identify human trespassing, smokes etc.

Mapping canopy gaps

Forest canopy gaps created either naturallyor artificially play a significant role in trees regeneration and understory biodiversity via regulating the abiotic factors like solar radiation, water and nutrients to the understorey (Devagiri et al., 2016). The spatially explicit distribution of canopy gaps cannot be quantified with traditional ground-based methods, like vertical tree crown projection or hemispherical photographs. Even tools like laser scanners, remote sensing and Airborne LiDAR are ineffective due to their increased costand low spatial and temporal resolution. Hence the drones can be used for accurately map all forest canopy gaps at high resolution. For example, Getzinet al., (2014) used the drone remote sensing images to analyses the canopy gaps of beech (Fagus sylvatica

L.) with different land use intensity in Germany.

Estimation of forest composition

Identifying and classification of the tree species composition of a forest helps to assess the economic value and provides valuable information for the forest ecosystems studies. Traditionally, the classification is done by multi or hyperspectral imaging or laser scanning from the aircrafts or satellites. These passive imaging has been based on sunlight, changing impacts and different illumination of tree crown. However, these images are not available at very high spatial and temporal resolutions. Hence three-dimensional hyperspectral remote sensing images from small UAVs can be used for classification of tree species. Nevalainen et al., (2017) used the hyperspectral and RGB camera in the UAV platform for classifying various tree species in Finland.

Forest stock inventories

Stem mapping, canopy height and tree diameter at breast height are core components of forestry which is used to estimate basal area, volume, crowding and successional condition. The main interest is to estimate forest carbon storage, timber yield and study the ecosystems functions. Most of the current remote sensing techniques rely on GPS signals, which are naturally poor under canopy dense forests. The drone platform mounted with LiDAR sensor was utilised for preparation of DBH and stem mapping in plantations of Singapore. It detected 73% of trees greater than 200 mm DBH within 3 m of the flight path but smaller and more distant trees could not be detected reliably. Lisein et al. (2013) used the small fixed-wing drone (1m wingspan and 2 kg weight) with 80km/h speed and 100-750 m height for the 40 minutes duration. They obtained NIR images with 7.6 m spatial resolution to reliably estimate the forest canopy.

Forest health inventories

Manual surveillance of forest health is impossible and also conventional remote sensing techniques are more time consuming, cost intensiveand with low spatial and temporal resolution. Lehmann et al., (2015) tried to monitor the splendour beetleinfestation in oak forests in Germany using Colour infrared camera in UAVs. A modified Normalized Difference Vegetation Index (NDVImod) derived classification was used for distinguishing between five vegetation health classes, i.e., infested, healthy or dead branches, other vegetation and canopy gaps. It offers a low-cost alternative to forest managers who aims a sustainable management strategy. Näsi et al., (2015) also used the similar UAVs technology for monitoring the European spruce bark beetle (*Ipstypographus* L.) in Norway spruce (*Piceaabies* L. Karst.) at Finland.Smigaj et al., (2015) monitored the infection levels of Red Band Needle Blight in Scots and Lodgepole pine (*Pinus sylvestris* and *contorta*) at central Scotland. They used the low-cost fixed-wing UAV-borne thermal system for monitoring the rise in canopy temperature induced diseases.

Modelling of forest ecosystem

High spatial resolution three dimensional measurements of ecosystems are important for scientific and environmental management like carbon accounting, ecosystem dynamics, risk modelling and suitability modelling. High structural and spectral information yields the unprecedented capabilities of 3D modelling. Dandois and Ellis (2013) attempted to make multispectral 3D modelling of canopy structure and spectral

attributes using inexpensive LiDAR based drone technology (rotary wing at 130 m height) in United States of America. Understory digital terrain models (DTMs) and canopy height models (CHMs) were generated from leaf-on and leaf-off point clouds.

Surveying and monitoring of wildlife

Wildlife is inseparable part of natural forests, so there is a need for theirsurveying and monitoring. It involves collection of data on their behavior, habitat and food resources which is an important area of forest conservation and administration. Numerous difficulties exist in conventional monitoring methods like less data collection efficiency, less accuracy, more costs, time consuming, difficult logistics, more manpower and training. Drones could be used for diverse applications ranging from the monitoring of bird nest counts (Weissensteiner et al., 2015) to surveying large elephants. Jones et al. (2006) used the fixed-wing UAVs for bird and reptile surveys. The continuous accurate counts will help to the find outevenminor population fluctuations owing to the lower type II error rate in statistical analysis. Sudhi (2017) reported that drones are used for monitoring of tiger in India. In the context of growing human-wildlife conflicts, drones can be effectively employed to identify conflict animals, conflicts hotspots and also used to warn people (Anon., 2015).

Forest fire monitoring

Traditionalforest fire detection involves looking from the high points or watch towers, patrolling by either using naked eye or binocular. Due to the risk and unreliability of the human based surveillance lead to the development of automated surveillance systems such as Charge-Coupled Device (CCD) cameras, Infrared (IR) detectors and automatic video surveillance systemsin recent years (Gharai et al., 2010). The aeroplanes or drones (UAVs) which will alert the occurrence of forest fire details to base stations in real time. Crewed aeroplanes for real time surveillance of wildfire are potentially damaging to the crews. So, drones are capable of using varieties of sensors without man at sites and efficiently transmits the data to ground station even upto 50 km. It isalso capable of hovering atop for several hours and can be commanded by joystick control or programming. Multispectral scanners mounted on drones can automatically collect image data ranges fromvisible to thermal infrared (TIR). The TIR-band will provideenhanced wildfire images. Uttarakhand forest department launched pioneer“Mavic Pro” drones for the fire monitoring in *Bhabar* and *Terai* regions. These drones can be able to fly more than 5000m MSL and 65 kmph with 21-minute flight time.

Precision forestry

Precision forestry employs highly advanced sensing technology and analytical tools to supports the site-specific, economic, environmental and sustainable decision-making for the forest sector. It greatly relied on precise, detailed, repeatable, fast, spatially explicit forest inventory characterizations and structural information. Application of fertilizer and irrigation should be at the right time and in the right place. The near infrared imagery obtained from an unmanned aerial system (UAS) were used onmacadamia tree canopy health classification in Australia. The spectral radiometry from the macadamia canopy was used for calculating the Canopy Chlorophyll Content Index (CCCI) which positively

correlated with the leaf nitrogen levels. This information is integrated with farm management software (PAM Ultracrop) and used in GPS--controlled fertilizer for effectively controlling the nitrogen spreading levels. This intervention savedfertilizer cost, increased production, increased economic returns and also reduced environmental hazards. Forest population control is a vital factor for improving forest productivity. Utilizing the high density airborne Laser Scanner (ALS) data from drones the rate of pruning in a *Eucalyptus globulus* stand inAustraliacould be tracked. Recently Sharma (2017), reported that drones wereused for seed bombing in forest areas near Bangalore.

Conclusions

Applications of drone remote sensing technology in forestry are rapidlyexpanding thanks to huge investments, new business ventures and availability of operating models. The present form of UAVs technologies is still at an initial phase, but is soon expected to outrun crewed aircraft remote sensing in the near future. Drone remote sensing provides more stability, safety, control, reliability, sensors choices and UAVs autonomy which are positive signs for those interested in applying this technology in the field of forestry. The need of the hour is to indulge in systematic and continuousR & D works to develop the appropriate/standardize drone remote sensing technologies for diverse forestry conditions prevailing in India.

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Effects of industrialization on environment

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Since as far back as we know, all religions of the world propagated that a clean environment was fundamental for the growth of community, both for its individuals or collectively in their endeavours. This explains why primacy was given to invoking magnanimity of elements before any enterprise was undertaken. The objectives was not purely religious, but to underline and ensure proper regards for environmental bounties like earth, air, water, etc. whose utilization was ordained to be done judiciously and with universal approval. Over the centuries, unfortunately, man in his capriciousness has reached a stage where the all-round development, that was said to be the reason behind the exploitation of natural resources, now looks ephemeral and not worth it. We seem to be almost veering round to the view that perhaps our approach had been shortsighted, if not completely irresponsible. Planet earth is heading towards becoming unlivable and its resources are nearing extinction due to over exploitation.

Development and environment have been the issues at debate ever since industrialization brought in quick prosperity to the Western World. In its haste to amass wealth, the natural resources were exploited blindly. The result was what we see today. The cities and towns are too crowded, too noisy and too unhygienic for healthy human living. The forests are denuded leading to increased disturbances in the weather and water table. Oceans are not only polluted but are getting shore of their natural wealth through human voraciousness. The atmosphere is beset with the looming danger of depleting ozone layer. The earth through over exploitation is losing its fertility. What a scenario which we are going to bequeath to posterity.

The question of environment protection is not only linked to the quality of life but to the very survival of millions of people. Large scale destruction of forest and vegetable cover, contamination of rivers and other water bodies, rise of air pollution in urban areas, is the beginning of the end. According to FAO estimates, 7.3 millions hectares of the world's tropical forests disappear each year. Fertile lands are lost at a rate of 25,000 square miles every year, and it is the most productive tracts of lands which are lost lying in the fertile earth belts, in the deltas and flood lands of our major rivers.

When man begins to interfere with the order and system that nature has so interestedly arranged in an act of seeming

revenge, he further upsets the delicate balance in the planet's eco-system by causing death and destruction through floods, droughts and epidemics.

The environmental scenario in India is alarming in all its aspects. Almost all surface water is unfit for human consumption. It is estimated that 73 million lives are lost every year due to poor water quality, sanitation and hygiene. WHO data shows that 21 per cent of all communicable diseases in India are water related. All the 16 major rivers, lakes and other water bodies have become contamination of ground water resources has reached a critical stage. Over exploitation, enhanced pumping intrusion of saline water in coastal areas, discharge of toxic effluents on land and in water bodies have all led to a decline in water table and serious contamination of ground water resources. The Ground Water Board has identified 231 blocks in the Country where ground water depletion has reached critical levels. Since a majority of population in the Country relies on ground water even for drinking water, the situations called for immediate steps in regulating the use of ground water and prevent contamination. Though various government bodies exist under the Ministry of Water Resources, none was empowered to take action against polluting industries or against misuse of ground water.

In all the big cities, the number of vehicles playing on the roads has increased phenomenally. As a result of the noxious emissions into the atmosphere, heart problems, respiratory diseases, asthma etc. are on the rise. Lead is a poison which attacks the blood system, kidneys, and central nervous system, reproductive and other systems.

Vehicles are not the only source of pollution, other sources of urban air pollution are, power plants, industries and refuse burning. According to a report by The Lancet Commission on pollution and health (2015) on Environmental Cost, more than 1.59 million premature deaths take place in India. The Tata Energy Research Institute's study entitled "Green India 2047" on air pollution, places the mortality and morbidity due to air pollution to be 2.5 times higher in the capital than predicted earlier. Taking into account the indoor air pollution as well, it has estimated that an astounding 2.2 million Indian die annually due to air pollution. Without food an adult can survive for three weeks, without water for three days but without air not more than three minutes. So much is the importance of fresh air to life in over sacred texts that water is compared to father and earth to mother, air has been equated with God.

India's population has expanded from 361 million in 1951 to around 1027 million in 2001. The population of India increased by more than 2.8 times during the period of 1951-2001. Census 2001 has shown that 285 million out of 1027 million Indian reside in about 4000 urban agglomeration. Forty per cent of urban population are poor and live in slums or foot paths without any access to safe drinking water and sanitation facilities.

Today India's population crosses 1.36 billion marks. The urban population is expected to grow to 600 million by 2031 AD. Over the year there has been a progressive decline in the availability of essential services as well as in the quality of life in urban as well as rural areas, urban poor have been the worst affected segments in this changes. The health and environmental consequences of increasing

population density, lack of safe drinking water and inadequate urban sanitation are likely to be further aggravated unless steps are initiated to improve the situation through sectoral coordination and appropriated and innovative technologies for safe management of both urban solid and liquid wastes.

Forests are among the most basic life support system of our planet. They support an extremely rich biodiversity which provides a wide variety of products and services. They are extremely important for regulating water flow in rivers. Forests, apart from producing food, fodder, fiber, timber and non-timber products, regenerate and improve air quality through the process of photosynthesis through which they harvest solar energy by utilizing carbon dioxide and water. In this process, trees and the green plants give out oxygen which is an essential requirement for all living organisms on this planet. The importance of forests in soil formation and conservation is extremely crucial.

The recorded forest area in India is 79.42 m ha. But all the recorded forest does not have adequate tree cover. According to landsat imagery of 2015, the area covered by forests is only 70.17 m ha. Today, India has less than two per cent of the total forest area in the world, but supports over 18 per cent of the world population. The per capita forest area has decreased from 0.20 hectare in 1981 to 0.07 hectare in 1994-95. By Comparison, the average per capita forest area for the world is 0.08 hectare.

With the pressure of growing population, agriculture, urbanization and rapid industrial development, forests have suffered progressively. There has been a continuous demand of forests lands for non-forest uses which has affected the forest cover in this country in a serious manner. In addition, deforestation caused by excessive and illegal free felling has vastly increased to gain short-term profits by mortgaging future well-being. Deforestation has created complex and wide-ranging problems in the form of soil erosion, flooding, landslides, excessive siltation of rivers and reservoirs, affecting the local population and economy adversely. With the destruction of forests, thousands of plants and animal species are threatened with extinction. The rain forests in the North-East and in the Western Ghats support an incredible diversity of species. The forests loss is causing severe damage well beyond the forests themselves. Large-scale clear cutting often leads to severe soil erosions which can choke rivers and streams. Forests loss can also reduce and areas water retention capacity, thereby causing extensive floods.

The subject of environment and development has become a critical topic especially in the context of the modern race towards industrialization. As more and more industrialization is taking place leading to sizable increase in national income, the costs in terms of permanent loss of limited environmental resources is also being realized in most quarters. Experts across the world are searching for models which would yield ‘industrialized development’ which at the same time is ‘environment-friendly’. The search is still on but the ‘trade offs’ in terms of destruction of environment has become continuous phenomena.

Development and environment need not be looked upon as contradictions but as complementary. Both propose reasonable parameters to each other. Both are necessary for growth of human society, and of nations. A balanced and buoyant

environment is fundamental not only for continued development efforts, but also for ensuring quality of life. A cleaner environment means less pollution, less misery and would result in greater productivity that would lead to development. This interdependence has to be properly understood and practiced. And that is possible through a pragmatic blend of urgency for development and the need to preserve the environment. The answer lies in evolving an enlightened view through enhanced awareness.

Fritillaria roylei Hook f. in Himachal Pradesh

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Botanical name: *Fritillaria roylei* Hook. f.
Vernacular names: Kshirkakoli, Sakakal misri.
Family: Liliaceae
Habit: Herb-perennial
Habitat: Sub-Alpine/Alpine Slopes/ Meadows, Shrubberies.

Introduction

The importance of Ashtavarga group of herbs to medicines have lead to the over exploitation of most of the species. Many of these are close to extinction due to over harvesting or un-skilled harvesting. *Ashta* means eight and *varga* means group come under the poly-herbal formulations. The conservation, assessment and management plan (CAMP) workshop recommended that the state of Himachal Pradesh has a tremendous potential to conserve and develop the Ashtavarga group of MAPs. It strongly proposed in drawing up a five year action plan for priority research and conservation action in respect of the 'Ashtavarga' group of herbs.

The state of Himachal Pradesh is considered a veritable emporium of MAPs in the Western Himalayan region. The local people have traditional rights of collection and further selling medicinal herbs, roots, flowers, fruits and aromatic plants from forests. Due to increased demand and competition among the harvesters, the populations of the majority of the species have dwindled manifold and have become threatened in their habitats. These species of Ashtavarga too have now been assessed as endangered based on perceptions of changes of species parameters, although quantitative data are lacking, and surveying is recommended to collect such information (Ved et al., 1998; 2003).

Fritillaria roylei Hook f. (Himalayan Fritillary) is a herbaceous plant, 0.5-2 ft

tall, commonly found in alpine slopes and shrubberies of the Himalayas, from Pakistan to Uttarakhand, at altitudes of 2700-4000 m. Flowers are yellowish-green to brownish-purple and usually with a chequered pattern in dull purple. Flowers are broadly bell-shaped, hanging looking down, borne singly on the stems, but sometimes in groups of 2-4. Petals are narrow-ovate. 4-5 cm long. Leaves are linear-lancelike, often long-pointed, 5-10 cm, arrange oppositely or in whorls of 2-6 on the stem. Flowering occurs in June-July. Few experts claim that the *Fritillaria roylei* is the real species which contains essence and the medicinal constituents of the species. This species is being sold at very high price in the market which resulted into exploitation of the species at large scale and species has came under critically endangered status as per CAMP Workshop, 2010. This species is used in Ashtavarga which is a combination of eight rejuvenating drugs in preparation of the famous Ayurvedic tonic Chyavanprash (Goraya *et al.*, 2013).

Status of the species

IUCN categorized the species as critically endangered (CR) for Uttarakhand and endangered (EN) for Himachal Pradesh and Jammu and Kashmir (Anon., 2003).

Red-list status of candidate species as per Shimla CAMP, December, 2010, the species has been categorized as endangered (EN) for Himachal Pradesh.

Uses

The bulb is supposedly antiasthmatic, antirheumatic, febrifuge, galactogogue, haemostatic, ophthalmic and oxytoxic. It is boiled with orange peel and used in the treatment of TB and asthma.

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Importance of butterflies in ecosystem

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Butterflies are chiefly diurnal group of order Lepidoptera. It is a diverse insect, found in many colours and sizes. India has one of the richest and diverse butterfly faunas with 1641 species representing more or less 9.50 % of the total butterfly species of the world (Varshney, 2006). Their survival depends on nectar that is produced in flowers and extra ripe fruits. Butterflies play vital role in the ecosystem, there is co-evolutionary relationship between butterflies and plants, their lives are interlinked (Echrlich, 1964). Butterflies are also called flying flowers, displaying its beauty.

Butterflies tend to favor big, colorful flowers that have a landing platform and gather pollen on their long, thin legs as they sip nectar from a flower. An abundance of butterflies usually indicates a healthier ecosystem. Butterflies act as environmental indicators because they are very sensitive and responsive to change in the habitat. They act as a food source and play a big role in the pollinating flowers that open during the day.

Metamorphosis is magic in nature; a beautiful butterfly emerges fully formed from a chrysalis that was spun from a crawling caterpillar. The butterfly begins life as an egg that hatch to a larva or caterpillar which grows pupa stage chrysalis. Butterflies play a number of roles in the ecosystem.

Pollination

Butterflies are pollinators and visit the flower to eat nectar. Tiny scales present on butterfly bodies, adhere the pollen grains from anthers, and when landed on another flower, scales brush against the stigma. Butterflies are diurnal and some smaller skippers (Hesperiidae) are only capable of using shallow blossoms. Butterflies with long proboscis can use the long narrowly tubular blossoms. Different species vary greatly in proboscis length. Although butterflies pollinate flowers less efficiently than bees, their role is still useful.

Monarch butterfly an iconic pollinator

Provide food for other animals

Butterflies provide food to a number of animals including birds, reptiles, amphibians, etc. and caterpillars provide an occasional meat for scorpions and ants. Eggs of the same flies & wasps live as parasites inside caterpillar's body and feed on it. If populations of butterfly diminish, then populations of birds, mice & other animals that rely on them as food source will also reduce. This loss will result into the collapse of the entire ecosystem.

Ecological indicators

In many regions of the world, Lepidoptera are accepted as the ecological indicators of the ecosystem health. Butterflies have high reproductive rate and are at low trophic

level, due to this they response quickly to environmental stress. Many butterflies are specialized for oviposition or feeding on a specific plant species. In a particular habitat, if butterfly is endangered then the plants, insects and vertebrates which live in that habitat are also at risk. Therefore endangered butterflies serve as a barometer of natural conditions in that habitat.

In the last ten years 72 % butterfly and moth species have declined (Dobson, 2012). Butterflies react quickly to minor changes in the environment providing an alarming signal for other reductions in wild life, thus making them good indicators of biodiversity. Some butterfly species are very sensitive even to light disturbances of natural forest. These species of butterflies are good indicators of natural forest.

Some species of butterflies migrate over a long distance, carry pollen to be shared across plants species and give a better chance of survival against different diseases. But the population of these insects is declining rapidly due to human activities, habitat destruction, uses of pesticides and unawareness of people about the importance of butterflies. A great way to help these insects survive is to eat organic food, avoid the use herbicides, landscaping and cultivate nectar plants in garden. These insects need our help and we need their invaluable contributions to save entire ecosystem.

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Potential biopesticides: Ivermectin and Spinosad

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Abstract

The present article succinctly reports the role of Ivermectin and Spinosad as potential biopesticides against insect pests of forestry importance. Further, the article presents the evaluation effects of Ivermectin and Spinosad against major forest insect pests of central India.

Introduction

Insects constitute one of the major limiting factors of forest produce. To combat these forest insect pests, toxins of biological origin or development of biopesticides is an pragmatic approach. Toxins of soil actinomycetes are one of the latest developments of recent research on biopesticides that represent a novel class of natural compounds with potent pesticidal activities. The discovery of different products, such as ivermectin and spinosad, from soil inhabiting actinomycetes has greatly influenced the arsenal of chemicals available for control of arthropod pests including insects. These toxins provide an ecofriendly approach of insect control and proved to be potential biopesticides against forest insect pests.

Actinomycetes

Actinomycetes are gram-positive bacteria with DNA rich in guanine plus cytosine. Actinomecetes are often regarded as the prokaryotic equivalent of fungi. They are widely distributed in soil, composts, water and other environments.

Actinomycetes produce large numbers of antibiotics with a variety of chemical structures. Indeed, antibiotics have been regarded as typical secondary metabolites. From the industry's point of view, by far the most important sector originating from actinomycete products is that of antibiotics. In addition to the production of pharmaceutical agents such as antibacterial, antitumour and antifungal agents, the actinomycetes have also proved themselves to be a source of novel and very powerful agents in the control of a variety of animal parasites, arthropod pests, animal and plant pathogens in agriculture and forestry.

Development of Ivermectin and Spinosad

The natural products produce by soil actinomycetes, viz. avermectins (Ivermectin) by *Streptomyces avermitilis*, milbemycins by *S. hygroscopicus aureolacrimosus* and spinosyns (Spinosad) by *Saccharopolyspora spinosa*, are of significant commercial importance due to broad insecticidal activity against many pests of agricultural crops, ornamentals, forestry, greenhouse, garden and households.

Experimental results

Ivermectin and Spinosad have been tested extensively against agricultural insects and proved to be highly effective natural products for management of insect pests. Recently, Ivermectin and Spinosad have evaluated against the larvae of *Ailanthus* webworm, *Atteva fabriciella* Swederus (Lepidoptera : Yponomeitidae) (Fig. 1), greater bamboo leaf roller, *Crypsiptya coclesalis* Walker (Lepidoptera : Pyralidae) (Fig. 2), teak leaf skeletonizer, *Eutectona machaeralis* (Walker)

(Lepidoptera : Pyralidae) (Fig. 3), teak defoliator, *Hyblaea puera* Cramer (Lepidoptera : Hyblaeidae) (Fig. 4) and *Albizia* foliage feeder, *Spirama retorta* Cramer (Lepidoptera : Noctuidae) (Fig. 5) and proved to be highly effective in inducing 100% larval mortality in laboratory, when sprayed on host plant leaves and larvae of the insect pests together. Both the biopesticides may be tested under nursery stage during outbreak period of the target insect pests.

Recent development of biopesticides, viz. ivermectin and spinosad, reveals that both of these are non-toxic, eco-friendly and pragmatic for management of insect larval defoliators in nurseries and young plantations.

Fig.1. Larval mortality in *Atteva fabriciella*, due to treatment of Ivermectin

Fig. 2. Larval mortality in *Crysiptya coclesalis*, due to treatment of Spinosad.

Fig.3. Larval mortality in *Atteva fabriciella*, due to treatment of Ivermectin

Fig. 4. Larval mortality in *Hyblaea puera*, due to treatment of Spinosad

Fig. 5. Larval mortality in *Spirama retorta*, due to treatment of Spinosad.

Significance of wood seasoning

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The process of inducing evaporation of the moisture contained in wood; a type of hydrothermal treatment of wood is known as wood seasoning.

The purpose of seasoning is to reduce the moisture content in the wood to a level appropriate to the use of the articles made from the wood. This prevents changes in the dimensions and shape of the articles, eliminates wood rot, increases the strength of the wood, reduces the weight of the articles, strengthens glued joints, and improves the quality of finishing. Wood is seasoned in various forms: lumber, peeled or planed veneers, crushed wood particles, and semi-finished articles.

The simplest method of seasoning lumber is open-air seasoning, in which the lumber is stacked in the open air or under canopies for a period of two or three weeks to several months. The principal industrial method, kiln drying, uses kilns fed with hot air, a mixture of air and fuel gases, or superheated steam. Kilns with steam are the most commonly used type. Continuously operating kilns are used primarily for large-scale seasoning of lumber prior to shipping; moisture content is reduced to 18–22 percent. Batch kilns are used to season wood to a moisture content of 7–10 percent.

The reduction of moisture content causes irregular drying of the wood, and internal stresses arise that may cause cracks to form. In order to prevent this, the relative humidity of the drying agent is lowered and the temperature is raised in the course of the seasoning process. Conditions for kiln drying lumber are standardized in the USSR. Depending on the desired intensity of the process and the later use of the wood, the following regimes are used: mild (temperature at the start of seasoning is 40°–50°C), normal (60°–80°C), accelerated (80°–100°C), and high-temperature (over 100°C). The length of the process varies from 15–25 days (mild regimes for hard woods) to 20–30 hr (high-temperature regimes for soft woods). If the wood is to be precision machined, it is steam-treated after seasoning to remove internal stresses. Seasoning in a high-frequency electric field is also used.

Continuously operating roller driers are ordinarily used for peeled and planed veneer. The sheets of veneer are surrounded by hot air (110°–130°C) or fuel gas (150°–250°C) and are moved through the drier on roller conveyors. The process lasts two to 12 minutes. Presses in which the plates are periodically opened and closed may also be used to season veneer. The temperature of the plates is 130°–170°C, and the process lasts up to

two minutes. A promising method for the future is the processing of peeled veneer in a continuous ribbon, rather than in sheets, in driers with forced ventilation through nozzles and metal belt or roller-chain conveyors.

Crushed wood particles for chipboard are seasoned primarily in gas drum driers at temperatures up to 500°C. Pneumatic units in which the particles are seasoned while suspended in a gas stream are also used. For packing chips and small semi finished articles, such as matchsticks, belt driers are used in which heated air is circulated around a layer of material on a mesh belt.

Wood in all living trees contains water. The amount of water thus contained varies with the kind of wood, the conditions under which it grew, and the season. It frequently happens that in the sapwood, and sometimes in the heartwood, the weight of the water is more than the weight of the wood substance itself. Thus, the gums when dried may weigh less than half their weight at the time of cutting. In general, as soon as timber is cut it begins to lose the water it contains. This loss of water is called "seasoning." In addition to the loss of water, other changes occur, such as a fixation or transformation of organic and inorganic materials stored in the wood, and an apparent "oxidation" of the wood substance.

The purposes of seasoning are:

- To prevent injury by insects and decay before the timber is placed in service.
- To increase the durability of timber in service.
- To prevent shrinking and checking of the wood in service.
- To increase the strength of the wood.
- To decrease the weight of the wood and hence reduce shipping charges.
- To prepare the wood for its injection with preservatives and for other industrial uses.

It is well known that if wood can be kept dry it will not decay. House furniture, for example, under ordinary conditions of use will, as far as decay is concerned, last indefinitely. It is solely because of their protection from moisture that the wooden coffins used by the Egyptians have been preserved to us. Water in wood is an absolute requirement for decay. Wood, which can be kept dry, will never decay. Just how much water in wood is necessary in order to meet the requirements of wood-destroying fungi is not known, but from a few tests, which the author has made it, appears that it is in general more than 20 percent.

It has almost unanimously been held that seasoned wood placed in conditions of service where it is subject to decay will last longer than unseasoned wood. While this is sometimes true, nevertheless the importance, which has been attached to air

seasoning as a means in it of prolonging the life of wood, has probably been exaggerated. Authentic records on posts, poles, ties, and mine timbers kept by the Forest Service indicate that there is little or no difference in their durability whether they were placed grean or air seasoned.

If green timber is used for construction purposes, it will almost invariably lose water and hence check, shrink, and warp more or less severely. In order to avoid such defects, it is policy to use seasoned wood in place of green in all classes of construction where they prove objectionable. Furthermore, wood, which has been seasoned prior to injection with preservative, is far less liable to check on the surface and thus expose the untreated wood.

The decrease in weight due to seasoning is so large as to warrant holding the timber until seasoned before shipment is made. This fact is now so well recognized that it has become common practice, but because of unfavorable conditions surrounding the seasoning of wood at the place where it is cut, the shipment of green material is sometimes imperative. A single carload of 30-foot chestnut poles if shipped seasoned rather than green would save at least 150 pounds of freight per pole, or, counting 50 poles per car, a total of 7500 pounds. What is true for poles is true even to a greater extent for smaller products because they season more thoroughly.

It is in the preparation of wood for injection with preservatives that seasoning plays a very important part, as it is quite essential to remove some or most of the water from the wood before the preservative can be injected.

Water may be considered as existing in wood in two forms: (1) as "free water" in the cell cavities and (2) as "confined water" in the cell walls. When wood begins to season, it is the free water, which is first, lost. Wood can lose all of this free water without its strength being affected. Just as soon, however, as water starts to leave the cell walls the strength of wood begins to increase very rapidly, and checking, warping, and splitting are liable to occur. Tiemann the "fiber-saturation point" has called the point where this occurs. It varies in the different species but in general ranges from 25 to 30 per cent moisture. When the free water has left the wood, the wood of course contains a larger air space or volume, which can later be occupied by a preservative like creosote. This may be illustrated as follows: Assume the oven-dry weight of shortleaf pine is 32 pounds per cubic foot, that solid wood substance weighs 97 pounds per cubic foot, that green shortleaf pine contains 21 pounds of water per cubic foot; then about two-thirds of a cubic foot of green pine would be wood substance and water, leaving about one third of the volume air space. If, now, all the free water were removed, almost two-thirds of the cubic foot of wood would be air space capable of occupancy by the preservative.

Aside from the loss of water, which takes place in seasoning, other changes occur. The bordered pits become more or less ruptured, or changed in position, so that passage of liquids through them is facilitated or retarded. Furthermore, the wood cells frequently check as well as the

surface of the wood. Because of these changes, which occur in seasoning wood, practically all processes now call for some kind of a seasoning treatment before the preservative is injected. The chief exception occurs in the Boucherizing process, which is at present of no commercial importance in the United States. Five methods of seasoning wood are now practiced: Open-air seasoning, seasoning in hot air, seasoning in saturated and superheated steam, and seasoning in oil.

Open-air seasoning, as the term implies, consists simply in piling the timber out of doors where it is exposed to the atmosphere. When its moisture content reaches equilibrium with the atmospheric moisture, the wood is said to be "air seasoned." It can thus be seen that the amount of water in air-seasoned wood varies considerably. Thin pieces of wood 2 inches or less in thickness in our northern climates, when air seasoned, contain about 10 to 15 percent of water. Thicker pieces like poles, ties, etc., are, under the same conditions, "air seasoned" when they contain 25 to 35 percent of water. Some Douglas fir bridge stringers 8 inches X 16 inches in cross section contained over 25 percent of moisture after being exposed to the atmosphere for 2 years.

The open-air seasoning of wood is the method most commonly practiced in the United States to prepare it for injection with preservatives. It is cheap, safe to operate, and very efficient. The chief objections to it are the long length of time the wood must be held before it seasons, thus tying up capital in wood and yardage, and dangers from fire, insects, and decay while stored during the seasoning period. In some parts of our country where the climate is warm and damp it is impossible to air-season certain woods without having them attacked by incipient decay. Other objections to air seasoning are an inability to fill "rush orders" and injury from checking, although this latter objection can be largely overcome by proper methods of piling.

Most efficiently season wood in the open air, it is necessary to subject it to a free circulation of air. Stagnant air is very prone to foster decay. The seasoning yards should, therefore, is in situations exposed to the sun and wind. All of the timber should be raised off the ground and should be piled as openly as possible without producing too rapid drying, which might result in serious checking or splitting. Another precaution is to keep the yard free from water, vegetation, and decaying wood.

The rate at which wood seasons depends upon many factors, chief of which is the time of the year. Spring and summer are in general the two periods when most rapid seasoning occurs. When wood has once air seasoned, any water, which it might absorb from rains, for example, is quickly lost. Air-seasoned poles tested by the author absorbed 15 pounds of water during a thunderstorm but lost all of it within 24 hours after the rain stopped. It is by no means necessary to season wood until it has lost all its free water before it is in satisfactory condition for treatment. Large products such as ties and poles may have, when "air-seasoned," an average of 30 percent of water, but the distribution of this water may vary from 5 to 10 percent in the outer layers of wood as a minimum to 40 or 50 percent in the inner layers as a maximum. If a tie or pole is of such a nature (as is customary) that interior cannot be treated even if it is dry, little or no advantage is gained in attempting to

hold it until this condition of uniform dryness is reached. The object, therefore, in open-air seasoning should be to cut the period of drying as short as possible without decreasing the penetration of the preservative. No fixed time can be given for this, as it depends on too many variables, which must be worked out for the conditions at each plant.

Hot-air Seasoning By "hot-air seasoning" is meant kiln drying the wood. This method is now only practiced in the United States on certain kinds of lumber and small manufactured products. It is rarely if ever used for large products such as piles, poles, and ties. In Europe, however, the method is sometimes employed, especially as a final drying for timber already partly seasoned in the open air. It is felt that the method will not become common practice in our country because equally as good if not better results can be secured in shorter time and at less expense by other means. The method employed in hot air or kiln drying consists in placing the wood in a retort or kiln, where the air is usually heated by means of steam coils. Circulation of the air is provided for in various ways, either by blowers, or by cooling the air on the sides of the kiln, or by drawing in air through vents in the bottom of the kiln and permitting the hot air to escape through vents in the top. Such treatment results in removing the water from the wood in much shorter time than open-air seasoning and in addition warms the wood for the entrance of the preservative. Wood so heated is, however, liable to check and warp seriously or case-harden, thus becoming weak and brash. For the treatment of small products of comparatively high value, this method gives very satisfactory results, but for dimension stock or products, it has little to commend it.

Next to open-air seasoning, seasoning in saturated steam is in most extensive use in the United States as a means of drying wood for the injection of preservatives. When properly done this method give quick and satisfactory results. Its chief advantages are the ease, quickness, and comparative cheapness with which the water can be drawn from the wood, the warming of the wood prior to its impregnation, and the sterilizing of the wood. When this method is practiced, a large storage capacity for wood and a large stock on hand are not necessary. Furthermore, "rush orders" can be taken care of and dangers peculiar to open-air seasoning are avoided. If steamed at too high temperatures or for too long a period, considerable injury may result to the strength of the wood. Steaming wood, in itself, does not re move water from the wood. On the other hand, it may add water, as shown in Table 34. In practice, to remove the water a vacuum is drawn. This lowers the boiling point of water and materially hastens the rate at which it leaves the wood.

Structural timbers, when seasoned for the injection of preservatives by the use of saturated steam, are loaded on cylinder cars or "buggies" and run into the treating cylinder, which is then closed and live steam admitted. The pressures used are about 20 to 40 pounds per square inch. The wood is kept in the steam bath for various periods, depending upon the judgment of the operator. It ranges from about 2 to 3 hours for ties to 10 hours or even more for piling. Tests made at the U. S. Forest Products Laboratory indicate that 5 to 8 hours are required to heat ties to the center by this method. After the steam bath, a

vacuum of 24 to 26 inches is drawn in the cylinder by means of a pump, and at the end of this period, the wood is ready for injection with the preservative. The length of time the vacuum is held varies greatly, but is usually from 1/2 to 2 hours. Nothing is gained by holding it after the wood has once reached a temperature below which no further heat units leave the wood.

Artificial seasoning is the process by which lumber is dried using fabricated devices such as a kiln. Regular wood seasoning is done by air-drying in conditions below 18 percent moisture. Multiple advantages to having wood artificially seasoned relate to the quality, strength and cost of the wood.

When you are using a natural drying process, you are at the mercy of the weather to give you ideal wood-drying conditions. This could take a lot more time and delay the sale or productive use of your wood. By using artificial seasoning with a kiln, you reduce the time necessary to dry your wood. This means that you can move it out quickly. The time factor is especially important for large lumber companies.

Saving time saves money by allowing you to sell your wood faster and to prepare room in your storehouse for more wood. In addition, shipping costs are often directly related to the weight of shipments. If you have dried the wood and reduced the moisture content, your wood will actually cost less to ship.

With the natural drying method, you cannot control the exact level of heat that you wish to use on your wood. Using artificial seasoning, you can adjust the temperature, as you need to. This will allow you to prevent drying degrade, which can sometimes occur when temperatures are too high.

Wood that has been artificially seasoned gains several qualities when it loses its moisture. Wood tends to increase in strength as it is seasoned. It is also easier to work with as it has less of a tendency to split, shake or warp. This means that the wood will be safer when it is used in machines. In addition, when wood has high moisture, it is problematic to paint or varnish, but when it is seasoned, the paint job can be much easier.

Many different elements can damage wood, including potential rotting, parasites, fungi and insects. Artificial seasoning will dry up the sap that creates an environment for fungi and parasites to live in. In addition, the high temperatures used in artificial seasoning will kill most if not all of the living organisms that are in the wood. Lastly, lower moisture content will prevent the chance for dry rot or any other type of fungal infection in the wood.

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Adverse effect of solar radiation on environment

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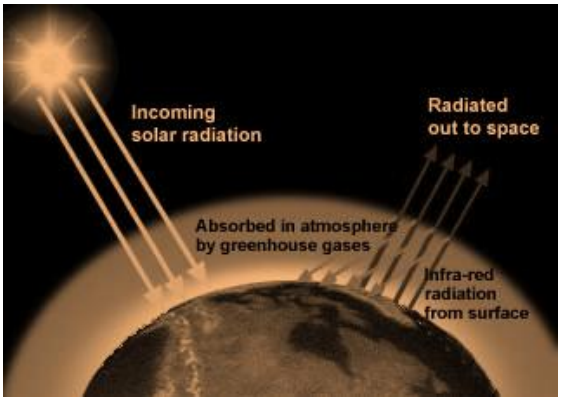

There are many forms of radiation. Some forms of radiation found in the natural environment and others are due to modern technology. Whether natural or manmade, radiation can be both harmful and beneficial to the environment. The sun, for example can have positive and negative effects on plant and animal life. At low levels, radiation can be beneficial to the environment. On the other hand, ionized radiation such as x-rays, gamma rays, alpha and beta particles can be particularly harmful in excessive amounts.

Natural radiation is often beneficial to plant growth. It is necessary for many plants to receive some form of non-ionizing radiation. Radiation that produces light in order for photosynthesis to occur is a positive effect that radiation has on plant life. However, according to the Environmental Literacy Council, ionized radiation that occurs from nuclear material may result in weakening of seeds and frequent mutations. For instance, a nuclear plant, called Chernobyl in Russia leaked in 1986 that caused excessive amounts of radiation pollution in that region. A huge cloud of radiation was formed which resulted in a massive amount of destroyed plant life; particularly pine trees in that area. High doses of radiation can be devastating to the environment.

The effect of radiation in the environment can be dangerous and fatal to humans and animals. The damage it causes depends on the level of radiation and the resiliency of the organism. Radiation causes molecules to lose electrons thus destroying it. Killing certain enzymes in the body can simply make you sick. However, once radiation damages DNA the body may not be able to repair itself. This can increase the chances of both animals and humans developing cancer. According to the US Department of Energy, after two nuclear explosions in Hiroshima and Nagasaki, survivors experience higher cases of cancer and child deformities. The nuclear explosions are examples of high levels of radiation. However, low doses of radiation can kill germs and decrease the number of food poisoning cases.

The effects that radiation has on marine life can be dangerous. High levels of UV or ultraviolet radiation can cause a reduction in reproduction capabilities. It can also disrupt the timing that plants flower, which can result in changes in pollination patterns. According to NASA, it can also reduce the amount of food and oxygen that plankton produces. Plankton can respond to excessive amount of UV-B or Ultraviolet-B light by sinking deeper into the water. This decreases the amount of visible light required for photosynthesis,

which reduces growth and reproduction. An increased amount of UV-B can also increase the amount of ozone produced at the lower atmosphere. While some plants can use this extra layer as a protective shield, other plants are highly sensitive to photochemical smog.

The sun radiates energy in a wide range of wavelengths, most of which are invisible to human eyes. The shorter the wave length, the more energetic the radiation, which is more harm. Ultraviolet (UV) radiation that reaches the Earth's surface is in wavelengths between 290 and 400 nm (nanometers, or billionths of a meter). This is shorter than wavelengths of visible light, which are 400 to 700 nm.

UV radiation from the sun has always played important roles in our environment, and affects nearly all living organisms. Biological actions of many kinds have evolved to deal with it. Yet UV radiation at different wavelengths differs in its effects, and we have to live with the harmful effects as well as the helpful ones. Radiation at the longer UV wavelengths of 320-400 nm, called UV-A, plays a helpful and essential role in formation of Vitamin D by the skin, and plays a harmful role in that it causes sunburn on human skin and cataracts in our eyes. The incoming radiation at shorter wavelengths, 290-320 nm, falls within the UV-B part of the electromagnetic spectrum. (UV-B includes light with wavelengths down to 280 nm, but little to no radiation below 290 nm reaches the Earth's surface). UV-B causes damage at the molecular level to the fundamental building block of life—deoxyribonucleic acid (DNA).

DNA readily absorbs UV-B radiation, which commonly changes the shape of the molecule in one of several ways. The illustration below illustrates one such change in shape due to exposure to UV-B radiation. Changes in the DNA molecule often mean that protein-building enzymes cannot "read" the DNA code at that point on the molecule. As a result, distorted proteins can be made, or cells can die.

But living cells are "smart." Over millions of years of evolving in the presence of UV-B radiation, cells have developed the ability to repair DNA. A special enzyme arrives at the damage site, removes the damaged section of DNA, and replaces it with the proper components (based on information elsewhere on the DNA molecule). This makes DNA somewhat resilient to damage by UV-B.

In addition to their own resiliency, living things and the cells they are made of are protected from excessive amounts of UV radiation by chemical called ozone. A layer of ozone in the upper atmosphere absorbs UV radiation and prevents most of it from reaching the Earth. Yet since the mid-1970s, human activities have been changing the chemistry of the atmosphere in a way that reduces the amount of ozone in the stratosphere (the layer of atmosphere ranging from about 11 to 50 km in altitude). This means that more ultraviolet radiation can pass through the atmosphere to the Earth's surface, particularly at the poles and nearby regions during certain times of the year.

Without the layer of ozone in the stratosphere to protect us from excessive amounts of UV-B radiation, life as we know it would not exist. Scientific concern over ozone depletion in the upper atmosphere has prompted extensive efforts to assess the potential damage to life on Earth due to increased levels of UV-B radiation. Some effects have been studied, but much remains to be learned.

Human health professionals and biological scientists would love to be able to demonstrate a direct correlation between the amount of exposure to UV-B radiation and the harm it causes. This is an enormously complicated question that depends on many different variables, such as varying degrees of susceptibility among different species, and most of these variables are not yet completely understood. For example, the same organism in different bodies of water in different parts of the ocean may respond differently to UV-B increases. Furthermore, stress to organisms and ecosystems from increased exposure to UV-B are modified by interactions among many other stresses, such as lack of water or nutrients. We live in a complex biosphere.

We know that increased exposure to UV-B radiation has specific effects on human health, crops, terrestrial ecosystems, aquatic ecosystems, and biogeochemical cycles. ("Biogeochemical cycles" refers to the cycling of chemicals such as carbon and energy throughout the Earth system.) This article will touch briefly on these effects, then will explain what determines how much UV we are getting and how we know.

The effects of UV-B radiation on human skin are varied and widespread. UV-B induces skin cancer by causing mutation in DNA and suppressing certain activities of the immune system. The United Nations Environment Program estimates that a sustained 1 percent depletion of ozone will ultimately lead to a 2-3 percent increase in the incidence of non-melanoma skin cancer. UV-B may also suppress the body's immune response to Herpes simplex virus and to skin lesion development, and may similarly harm the spleen.

Our hair and clothing protect us from UV-B, but our eyes are vulnerable. Common eye problems resulting from over-exposure to UV-B include cataracts, snow blindness, and other ailments, both in humans and animals. While many modern sunglasses offer some UV protection, a significant amount of UV can still reach our eyes in a high exposure situation.

With regard to plants, UV-B impairs photosynthesis in many species. Overexposure to UV-B reduces size, productivity, and quality in many of the crop plant species that have been studied (among them, many varieties of rice, soybeans, winter wheat, cotton, and corn). Similarly, overexposure to UV-B impairs the productivity of phytoplankton in aquatic ecosystems. UV-B increases plants' susceptibility to disease. Scientists have found it affects enzyme reactions that conduct fundamental biological functions, it impairs cellular division in developing sea urchin eggs, and it changes the movements and orientation of tiny organisms as they move through ocean waters. Since some species are more vulnerable to UV-B than others, an increase in UV-B exposure has the potential to cause a shift in species composition and diversity in various ecosystems. Because UV-B affects organisms that move nutrients and energy through the biosphere, we can expect changes in their activities to alter biogeochemical cycles. For example, reducing populations of phytoplankton would significantly affect the world's carbon cycle, because phytoplankton store huge amounts of carbon in the ocean.

Much of scientists' work to determine the effects of increased UV-B on the marine

biosphere has focused around Antarctica because the stratospheric ozone depletion there has been so dramatic, and because phytoplankton- which grow in abundance around Antarctica- form the basis of the marine food chain. Largely because of phytoplankton, oceans are responsible for the production of at least half of the organic material in the biosphere.

In the Antarctic, increased exposure to UV-B radiation due to the appearance of the ozone hole commonly results in at least a 6-12 percent reduction in photosynthesis by phytoplankton in surface waters. In a study of California coastal waters, effects of current levels of UV-B radiation compared to historical levels range from 40 percent reduction of photosynthesis by phytoplankton to a 10 percent increase. In fact, phytoplankton of the California coast sometimes turns out to be more susceptible to UV-B radiation than phytoplankton in Antarctica, to the surprise of biologists.

Communities of plants, animals, and microorganisms may be more resilient than we yet know. In spite of increased ultraviolet exposure in Antarctica over the last decade or so, no catastrophic events have occurred at the ecosystem level. However, the reason for this may be that the large ozone hole lasts only from September to December and covers a small geographic region relative to the entire globe. If the ozone hole should remain for longer time periods, or if ozone were to be reduced over a wider area every year, sooner or later, we could expect to see major ecosystem changes. So many studies in both the laboratory and the field have demonstrated serious consequences of increased UV-B radiation on the biosphere that we need to improve our understanding of the complex Earth environment and its responses to that radiation.

Know your biodiversity

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Nardostachys jatamansi

Nardostachys jatamansi a critically endangered rhizome-bearing aromatic plant belongs to Order Dispsacles and Family Valerianaceae. The plant is commonly known as Spikenard and Muskroot. In India this herb is known by different names in different regions *viz.*, Tapasvini, Vilomasa, Bhutajata, Jatamansi, Nalanda, Jatamashi, Balchar etc. Most commonly used name is Jatamansi which is made up of two words: *Jata* means dread locks and *manasi* indicates towards human.

Jatamansi is an endemic species to Himalayan region, occurring in India, Nepal, Bhutan, Myanmar and southwest China between an altitude range of 11,000-15000 ft. In India it is found in Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh.

Nardostachys jatamansi is a perennial, dwarf, hairy, rhizomatous herbaceous species forming a group of cluster of several individuals. It can attain heights up to 10-60 cm in general. The leaves are elongated and spatulated while few leaves are sessile, oblong or sub ovate. Stem is 10-60 cm long, more or less pubescent upwards and often glaborate from below. The flowers are pink in color and bell shaped. Corolla-tube is 6 mm long and somewhat hairy within, as are the filaments below. Fruit 4 mm long, covered with ascending white hairs, crowned by the ovate, acute and often dentate. Stamens are sub-equal to corolla in length and stigma is capitate. Calyx lobes are deltoid to ovate, 1.5-2.5 mm in size, prominently and reticulately veined. Roots containing a cylindrical rhizome covered with brown to deep grayish fibers. These roots are thick, long, solid and dark brown in color and hairy and because of this characteristic feature the plant is named as "Jatamansi". The plant has a long vegetative growth phase of 3-4 years followed by a short reproductive phase. Propagation of plant is clonal during the vegetative growth and rate of seed germination is very low in nature. Flowering of Jatamansi occurs from late June to August and fruiting generally seen in the months of August-September. Odor of the Jatamansi is slight and aromatic and taste is acrid, slightly bitter.

Jatamansi is also a natural brain nervine tonic and also helps in enhancement of memory. It has calming, peacefulness and relaxation features. It is an endangered Ayurvedic medical herb had been used since the ancient times for many medicinal purposes. In Ayurveda, it is prescribed against stress, spasm, epilepsy, convulsion and hysteria. In fact, it is one of the

excellent herbs to treat epilepsy. The plant in Ayurveda is also known as "tridoshamak" which means it can balance all the three doshas *viz.,* Vata, Pitta and Kapha. It also helps to provide vitality, vigor and strength to the body thus good for the nervous system. The plant is a wonderful medicinal herb used since ancient times for many medicinal purposes. Dried rhizomes and roots are the main medicinal parts used in preparation. The Jatamansi roots can be crushed and distilled into an intensely amber color essential oil which is very thick in consistency. This oil is used as a perfume, incense, a sedative and an herbal medicine which helps to fight with insomnia, birth difficulties and other minor ailments. The extract of jatamansi oil is helpful in the growth of hair. It is beneficial for smooth, silky and healthy hair too. It is used to improve complexion and ensures glowing and shining looks to the body. The root of the powder in water when applied promotes skin texture. Best uses of Jatamansi are that it is used to impart black color to hair and prevents graying of hair. Its medicated oil with almond is highly useful for smooth and silky hair. It is also beneficial for hyperactive children and helpful to reduce hyperactivity, restlessness and aggressiveness. The root of the powder is used to treat intestinal worms.

According to IUCN the species is assessed as Critically Endangered. The main reasons are loss of habitats and forest degradation. Excessive overgrazing of yak, sheep and other cattle groups in high altitude has now become a major threat for this species. This species is harvested for its roots and rhizomes and during collection whole plants are uprooted and disturbed. The species has sizeable market demand on account of its commercial use as a plant drug and as a result the level of exploitation is high. The rhizome is traded at local, regional and national markets. Due to high volume trade and demand, the species is collected from its wild habitat in an indiscriminate way and thus population is declining continuously. This also has a severe impact on natural regeneration. Similar threats are ongoing in Bhutan, China, Myanmar and Nepal, and therefore the status in India is considered representative of that of the species globally.

As *Nardostachys jatamansi* is restricted to specific pockets only in the wild and urgent steps for its conservation is utmost. In nature, superior *N. jatamansi* germplasm is found on moist, rocky habitat with rich organic carbon and nitrogen content. On the basis its occurrence, availability, germination behavior, morphological superiority and presence of active ingredient, identification of potential habitats for collecting and multiplying germplasm for future domestication and cultivation can be recognized and gainfully adopted for future conservation policies. *Ex situ* conservation of the species also assumes greater significance especially in a scenario when harvesting potential from the wild falls short of the demand for commercial exploitation. In this regard it will be pertinent to consider the specific preferred environmental requirement of the species before developing improved agro technologies for cultivation of the species.

Hemitragus jemlahicus

Hemitragus jemlahicus commonly known as Himalayan Tahr, belongs to order Artidactyla and Family Bovidae. The

Hiamalayn Tahr is one of the three species of tahr and is a relative of wild goat. The

other tahrs are the Arabian tahr of Oman, and Nilgiri tahr of Southern India. This animal species is specially adapted to life on the rugged mountains slopes and montane woodlands of the Hiamalyas.

Hemitragus jemlahicus is native to Himalayan region and found in China, Tibet, Nepal and parts of North India from Jammu Kashmir to Sikkim. It has been widely introduced elsewhere for hunting. After introduction to New Zealand in 1904 it spread to the entire suitable habitat there. They are also introduced in New Mexico, California, Ontario, and South Africa. They are the inhabitant of the steep rocky mountain sides, especially between 3,000-4,000 m, with woods and rhododendron scrub. They may also seasonally use mixed oak forests as low as 2500 meters and alpine meadows as high as 5000 meters.

Himalayan tahrs are 3- 4.5 feet long and weigh around 36-90 kg. They are 26 – 40 inches tall. They have relatively short legs and a small head. Eyes are larger in size and ears are small and pointed. Males are large than females. Average weight of male is 73 kg while female average weight is only up to 36 kg. Their hooves are well-adapted for their mountain habitat, with a hard rim of keratin surrounding a soft spongy convex pad, curved abruptly backwards and then inwards. These hooves and strong and allow them to be an excellent climbers. The Himalayan tahr is diurnal, and lives in small groups of 2-20 individuals, excluding older solitary males. In winters they dense, reddish to dark brown woolly coat with a thick undercoat. In the spring they lose much of their coat, and it becomes lighter in color. They reach the level of sexual maturity at 2-3 years of age and usually mating occurs from October to January in winters. Females leave their groups to give birth. The kid is able to nurse within a few minutes and can walk within three hours. Gestation period lasts for seven months and normal number per litter is one or two. Normal lifespan is 10-14 years, although individuals up to 22 years old have been reported. Females live longer than males. Accidental death due to rock slides or avalanches is not uncommon. The species commonly eats grass, other herbs and some fruits. During the winter it eats less due to poor food quality and high metabolic costs. It eats alpine herbs and subalpine scrubland plants

Though there is neither global population estimate, nor knowledge of rates of change The Himalayan tahr is considered near threatened by the IUCN in its home range of the Himalayas. The major threats of Himalayan tahrs are uncontrolled hunting and deforestation. Also in the Himalayas, *Hemitragus jemlahicus* is preyed on by the snow leopard which also leads to a threat to its population. In New Zealand and other areas where it has been introduced, its only predator is humans. Not only this they are widely hunted for sport and trophies and also for meat. Other threats of Himalayan region come from an expanding human population and accompanying increases in livestock, habitat loss, poaching and access. As a

result of these factors, tahr populations are becoming increasingly isolated. Avalanches during winters with high snowfall also can be a significant mortality factor for tahr. In its native habitat, *Hemitragus jemlahicus* now survives only as remnant populations due to hunting and habitat loss. In areas where it was introduced, it is doing well, but is often heavily managed.

In India, protected areas with Himalayan tahr are Jammu and Kashmir at Kishtwar National Park; Himachal Pradesh at Great Himalayan National Park, Daranghati Gamgul Siahbehi, Kanawar, Khokhan, Kugti, Manali, Rupi Bhaba, Saichu Tuan Nala, Tirthan and Tundah Wildlife Sanctuaries; Uttarakhand -Nanda Devi, Govind Pashu Vihar and Kedarnath Wildlife Sanctuaries; and Sikkim - Khangchendzonga National Park. Himalayan tahr occurs in a very narrow band along timberline areas in the Himalaya, and due to lack of population data conservation measures are very necessary. The proposed conservation measures for India can be the extension of the Great Himalayan National Park as these area falls under natural habitat of Himalayan tahr. Establishment of the proposed Srikhand National Park (Himachal Pradesh) and also devise innovative community based reserves for the species which include community based protection, tourism, awareness, etc. Such conservatory measures are important for Himalayan tahr as population trend of this species is already seems decreasing and there is urgent need to check before it falls under threatened category.

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