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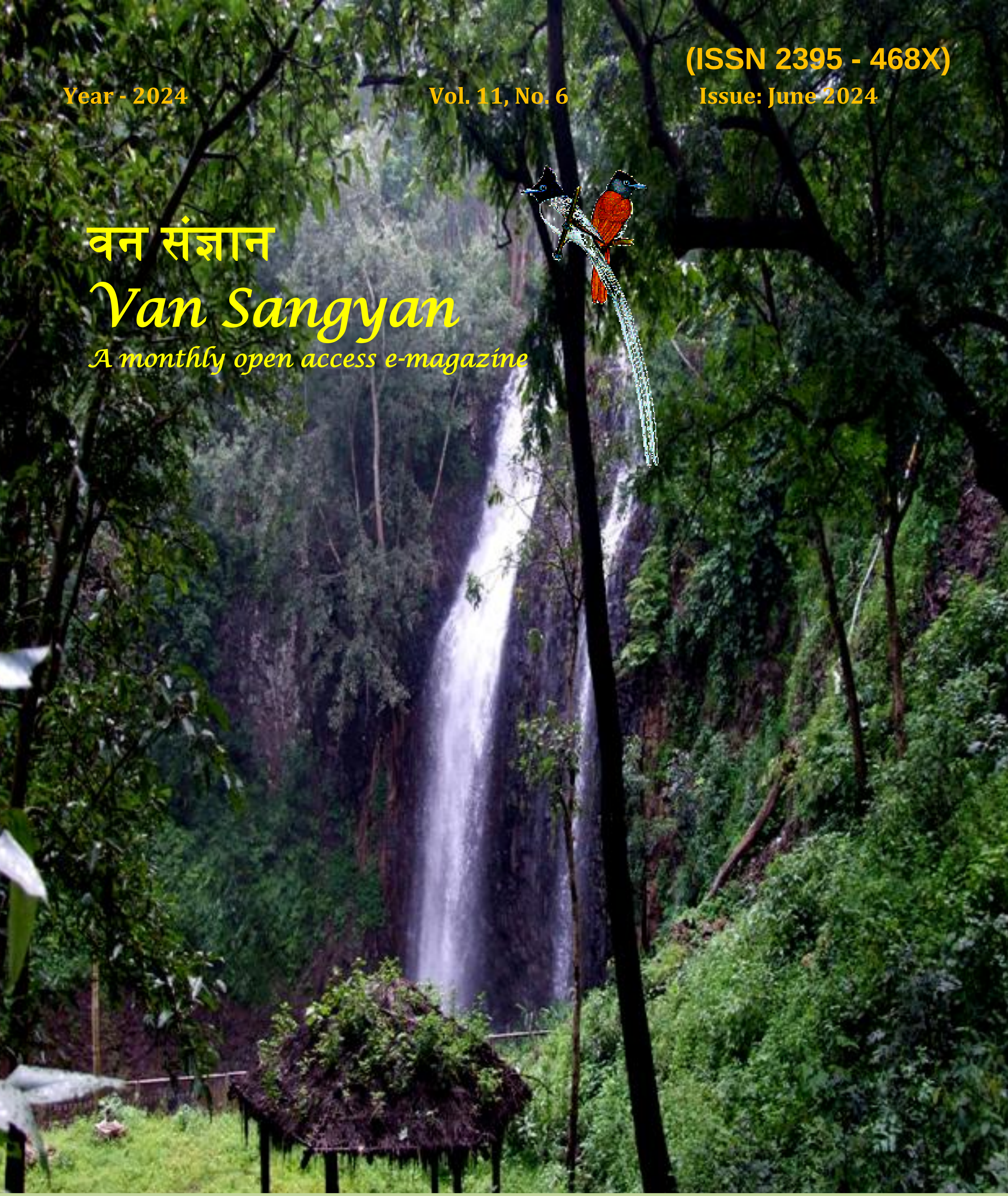

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Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve

From the Editor's desk

The rapid increase in the global population is straining land resources due to intensive farming practices that ultimately degrade soil quality. To ensure sustainable land use, it's crucial to maintain soil health. One common approach to replenishing depleted soil nutrients is the use of chemical fertilizers. However, their high cost poses a significant challenge, particularly for small-scale farmers. Moreover, improper and excessive application of chemical fertilizers can harm soil health by disrupting soil enzymes, microorganisms, and the environment, while also contaminating groundwater. This not only poses health risks and contributes to climate change but also reduces nutrient use efficiency, making chemical fertilizers less viable. Improving nutrient use efficiency is key to optimizing crop production, minimizing nutrient loss, and providing cost-effective nourishment. Historically, intensive cropping has been used to address agricultural challenges, but now, diminishing responses to inputs in rice-wheat systems highlight the need for better nutrient management. Crops typically utilize only 30-50% of applied nitrogen and 45% of phosphorus from fertilizers. Combining chemical fertilizers with organic manures can enhance nutrient efficiency.

In line with the above this issue of Van Sangyan contains an article on an overview of nutrient use efficiency and nutrient budgeting in crop production. There are also useful articles viz. Dendrocalamus stocksii: A Potential Agroforestry Species, Die-back disease of neem: An emerging issue in forest industry, Fire ecology – The role of wildfires in forest ecosystems, Embracing Wisdom from the Forest Man of India, मालवेसी परिवार की कुछ महत्त्वपूर्ण वनस्पतियों का सामान्य परिचय , Forest fire management for ecosystem restoration, Role of urban forests in carbon sequestration, Harvesting techniques: A key to promote management practices of bamboo and जैविक खेती में ट्राइकोडर्मा का महत्त्व.

Looking forward to meet you all through forthcoming issues

Dr. Naseer Mohammad
Chief Editor

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An overview of nutrient use efficiency and nutrient budgeting in crop production

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Introduction

By 2050, it is predicted that there will be more than 9 billion people on the planet, most of who will live in developing nations that are already struggling to feed their populations.The need for NPK fertilizer will rise in tandem with this population growth. Almost all cultivated soils in the world are deficient in one or more of the vital nutrients needed to support healthy plants.The need for food will rise in both quantity and quality as developing nations like India and other Asian nations become more urbanized. India is primarily an agricultural nation, employing 65% of its workforce in this sector. Until the mid-1960s, India's agriculture was primarily dependent on organic manure. However, with the arrival of the Green Revolution, enhanced high-yielding variety seeds and advanced irrigation systems, the country began using more high-analysis chemical fertilizers. The nation consumed just 0.06 Mt of N fertilizer in 1950–1951, but in 2000-2001, that amount rose to 10.8 Mt, a nearly 190-fold increase in just 50 years (FAI: 2000-2007). P fertilizer consumption has also increased significantly, from less than 0.01 Mt in 1950-1951 to 1.8 Mt in 2000-2001. Nonetheless, K fertilizer use has been extremely low, ranging from nearly non-existent in 1950-1951 to just 0.81 Mt in 2000-2001. Although agricultural production initially increased significantly along with the rise in fertilizer consumption, it eventually stagnated and began to decline. The amount of food available per person annually rose from 141 kg in 1950-1951 to 208 kg in 1990-1991 but fell to 192 kg in 2000-2001.This is a severe problem, and more needs to be looked into in order to close the gap between supply and demand and raise the amount of food available per person. It has been reported that the overall efficiency of applied fertilizer is approximately 40% for K, less than 10% for P, and approximately 50% for N. (Baligar *et al*., 2001). Nutrient-absorbing and utilizing plants significantly improve the effectiveness of fertilizers applied, lowering input costs and preventing nutrient losses to ecosystems. For a long time, improving fertilizer use efficiency (FUE) and lowering its detrimental effects on the atmosphere have been global priorities.It can be especially impacted by soil and irrigation management, as well as fertilizer management. The world's food demand is driving up demand for fertilizer nutrients, but there aren't enough of these resources available, and public awareness of the negative effects of nutrient use is growing.This has prompted demands for improving NUE without sacrificing crop productivity. The ability of the plant to absorb nutrients from the soil effectively is a major factor in determining nutrient use efficiency (NUE) which is also influenced by nutrient internal transport, storage, and remobilization.

What is Nutrient Use Efficiency?

Fertilizer use efficiency (FUE) or nutrient use efficiency (NUE) can be expressed as yield per unit input of fertilizer or as the amount of applied fertilizer that is recovered. When assessing crop production systems, the concept of nutrient use efficiency, or NUE, is crucial.

NUE and their applications (after Dobermann, 2007)

S.No.	Term	Typical use
1.	Partial factor productivity	As a long-term indicator of trends.
2.	Agronomic efficiency	It is used as a short-term indicator of the impact of applied nutrients on productivity.
3.	Partial nutrient balance	As a long-term indicator of trends, mostly used when combined with soil fertility information.
4.	Apparent recovery efficiency by difference	As an indicator of the potential nutrient loss from the cropping system and to assess the efficiency of management practices.
5.	Internal utilization efficiency	To evaluate genotypes in breeding programs; values of 30-90 are common for N in cereals and 55-65 are considered optimum.
6.	Physiological efficiency	In research, evaluating NUE among cultivars and other cultural practices, values of 40-60 are common.

How to increase FUE

The objective of nutrient use is to increase the overall performance of cropping systems by supplying economically optimal nutrients to the crop. For increasing NUE approaches are defined below:

Scientific nutrient management

Appropriate nutrient management in cropping systems should purpose to supply suitable fertilizers based on the demand of the crops and apply this method that reduces loss and maximizes the use efficiency.

Right rate

The most significant method currently available for assessing the soil's ability to supply nutrients is soil testing; however, high-quality calibration data is also required in order for the results to be helpful in recommending fertilizer.

Right time

It is connected to nutrient management that is site-specific (SSNM). Improved nutrient use efficiency, particularly for N, requires more synchronization between crop demand and nutrient supply (Giller *et al.*, 2004). It is well known that dividing up N applications during the growing season, as opposed to applying a big amount all at once before planting, improves N use efficiency.

Right place

The way fertilizer is applied affects how efficiently it is used. Fertilizer is applied primarily in two ways: before and after planting. Determining the appropriate placement is crucial in determining the application rate.

Integrated Nutrient Management (INM)

Integrated Nutrient Management (INM) entails making the best use of naturally occurring nutrients, such as crop residues, organic manure, biological N fixation, and chemical fertilizer, along with their complementary interactions to increase N and P recovery. Growing returns to farmers in terms of yield, soil quality, and NUE of applied N requires a proper understanding of and utilization of these beneficial interactions among plant nutrients (Aulakh and Malhi, 2004).

Use of modified fertilizers:

Use of slow-release fertilizers

A range of slow-release fertilizers is now marketed which have the potential to reduce various N losses and improve NUE (Giller *et al*., 2004).

Use of nitrification inhibitors

The addition of nitrification inhibitors can check the conversion of ammonium-N into nitrate-N and ensure a higher concentration of the ammoniacal form of nitrogen in the soil medium, to increase NUE and crop yield (Shivay *et al*., 2001). Nitrogen stabilizers [e.g., Nitrapyrin, DCD (Dicyandiamide), NBPT (n-butyl-thiophosphorictriamide)] inhibit nitrification or urease activity, there by slowing the conversion of the fertilizer to nitrate.

Use of organic and green manures

Use of conservation tillage for proper crop residue management

Reducing losses of nutrients

Nutrient Budgeting

Equilibrium between the inputs and outputs of nutrients in the farm or horticultural system is the goal of organic farmers. Because crop rotations are used and animals are a part of the system, nutrient management in such systems has a longer view than a single season or crop. When it is possible to quickly and easily create nutrient budgets for farms, these budgets can be used to guide decisions about nutrient management as well as to evaluate possible nutrient surpluses or deficits.

Nutrient budgets are commonly used in the following circumstances:

- As a tool to allow farmers and growers to make optimum use of available nutrients.
- To design and evaluate the viability and sustainability of arable and horticultural crop rotations by organic advisers
- To assess an arable or horticultural rotation or whole farm system against organic production standards by an inspector
- To indicate likely surpluses of nitrogen in the farm or horticultural systems and therefore risk of losses by leaching to ground and surface water, especially in environmentally sensitive areas or nitrate vulnerable zones.

A nutrient budget can be compiled for any one or all of the plant nutrients. Nitrogen is often the nutrient limiting crop growth and therefore it is often the first nutrient assessed when planning rotations. Where phosphorus or potassium levels are low in the soil, use of nutrient budgets may allow the use of supplementary fertilizing materials to be planned. Calcium and magnesium are less important and can, if required, be ignored unless potential deficiencies make them significant, e.g., in fruit growing, glasshouse tomato production or with livestock. In practice, the extra effort involved in completing a budget for all five nutrients is often negligible. Budgets are commonly compiled for an arable or horticultural rotation but can also be drawn up for whole-farm systems.

Types of Nutrient Budgets

There are three types of nutrient budgets: farmgate, soil surface, and soil system

Farm-gate nutrient budget

Accounts for, only how much nutrient is imported and how much is exported for the development of farm production. These nutrient inputs and outputs (e.g., Animal feed, fertilizers, crop, manure and animal products) can be readily tracked. Hochmuth and Bennett (2011) present an example of a farm-gate budget in their publication.

A soil surface nutrient budget

Consider all nutrients that enter the soil surface and leave the soil through crop uptake. In the case of N, the total amount of manure or fertilizer N applied would be adjusted to account for ammonia volatilization, since this N would not enter the soil surface. It also accounts for the nitrogen that has been lost in the field from the soil surface. In addition, the soil surface budget includes estimates of nutrient inputs such as biological N-fixation and atmospheric deposition.

A soil system budget

This is a different kind of nutrient budget because all nutrient inputs and outputs in a given area of interest are included in the budget. The soil system budget requires the use of assumptions and estimations to account for nutrient transformations in the soil (e.g., immobilization and mineralization) and nutrient export from the system (e.g., losses through runoff, leaching, volatilization and denitrification). Because a soil system budget relies on assumptions and estimates, more uncertainty is associated with this type of budget compared with farm-gate or soil surface budgets.

Nitrogen cycle

Understanding the nitrogen cycle is important when considering how to create a nitrogen budget. Nitrogen fertilizers are an irreplaceable part of agricultural production. However, when nitrogen is added to an agricultural system, it becomes subject to all the transformations contained within the nitrogen cycle. When all of the nitrogen applied to agricultural fields is not taken up by crops, the excess reactive N can cause environmental problems, including groundwater nitrate contamination and emissions of nitrous oxide, a potent greenhouse gas. An increased understanding of the factors that will affect the transformations of nitrogen allows for better management of this important nutrient.

Phosphorus cycle

Phosphorus is often a limiting nutrient in crop production and is fundamental for the efficient use of nitrogen fertilizer. The main target for optimal crop production is to synchronize phosphorus supply with crop plant requirements during critical stages of yield development. The maximum uptake rate of phosphorus by plants occurs around flowering but its accumulation continues until maturity. The amount of the P in the soil solution, and its proximity to the crop root, is decisive for both crop growth rate and nitrogen efficiency (Wang *et al*., 2010).

Summary

An effective management tool for quantifying the amount of nutrients imported into and exported from a system is a nutrient budget. Reducing the overapplication of fertilizers while maintaining or improving agricultural productivity or urban aesthetics is the aim of nutrient budgeting for farmers. For an agricultural or urban system, having a balanced nutrient budget greatly reduces the potential for pollution from excess nutrients and helps avoid needless production costs.

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Dendrocalamus stocksii: A potential agroforestry species

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Introduction

Dendrocalamus stocksii (Munro) is naturally distributed in Central Western Ghats. Itis locally known as 'Chivari', 'Mes' in Maharashtra; 'Konda', 'Oor-shema', 'Marihal bamboo' in Karnataka; 'Manga' in Goa.The culms of D. stocksii are medium-sized, robust, sturdy, and strong. Despite having a natural distribution in humid tropical regions with lateritic soil types, this plant is highly adaptable and may thrive in semi-arid and subhumid environments with black and red soils. For farmers in Peninsular India, it is the most favored plant, following *Bambusa bambos* and *Dendrocalamus strictus*. *D. stocksii* is regarded as a significant species for agroforestry, making it perfect for plantations in coastal and watershed areas. It is planted as pure block plantations or as a part of household gardens. It is typically seen on agricultural boundaries or as live fences in home gardens.This is a highly manageable species with significant ecological and economic value as well as the potential for widespread use. Because of its easily managed culms that are loosely spaced and non-thorny, this species is favored by bamboo users. In addition to being used as edible shoots and in handicrafts, it is a part of many agricultural tools, including stakes for crops like tomatoes, support posts for growing grapes and bananas, farm buildings, and live fences. In addition, it is utilized for walking sticks, scaffolding, paper and pulp, crafts, building, basketry, umbrella handles, and country boat navigation, among other things.Because cane and rattan are becoming harder to find, this species is being considered more and more as a replacement in the furniture business because of its typical anatomical traits, which include strong nature, good culm wall thickness, and the existence of non-predominant nodes. Peninsular India's National Bamboo Mission (NBM) has given priority to the large-scale production of this species due to its numerous applications and potential significance.

Habitat

This species is native to the Central Western Ghats, can be found in Maharashtra, Karnataka, Goa, and Kerala. Due to its need for deeply rooted soil that drains properly, its native range is primarily restricted to stream banks. *D. stocksii* is grown mostly around arecanut gardens and rice fields in the coastal areas of Karnataka (Seethalakshmi and Mukteshkumar, 1998; Devar, 2000).

Agroforestry

This species is an essential component of home gardens and is typically chosen for use as farm boundary plantations, particularly in the West Coast region. There have been attempts to include *D. stocksii* in agricultural systems, particularly in highland agricultural systems in the humid tropics along the Western Ghats, alongside crops. According to preliminary observations, culm emergence, culm collar diameter, and diameter at fifth internode of emerging culms under intercropping have significantly improved (Bhave et al., 2011). Every year, bamboo intercropped with fingermillet (S3) could yield up to 18 culms per clump, whereas sole bamboo (S1) could only yield about 8 culms per clump. Given that bamboo can efficiently use the management inputs provided to agriculture crops, this suggests that bamboo will perform better when interplanted with agricultural crops, at least in the early years. A key factor in determining an agricultural crop's yield is spacing. Although there is initially little variance in agricultural yield from the base of the clump, as a clump ages, it is doubtful that this tendency will be true as competition for resources may become more apparent and eventually result in a decline in yield.

Utility and potential

Because of this bamboo's inadequate seed lying and non-gregarious habit, genetic diversity may be severely limited, and ongoing vegetative multiplication from a limited genetic base may have detrimental effects on the species' ability to survive. The creation of a gene bank via genotype collecting throughout the genotype's natural distribution region is necessary. *D.stocksii* provides natural benefits such ease of clump management and harvesting due to its loosely spaced culm habit and robust, erect culm structure. It is becoming more widely acknowledged in the bamboo-based furniture business as an alternative to cane and rattan. It is simple to harvest and use because to its non-thorny nature and low branching habit. Boatmen favor this species in riverine parts of coastal Karnataka districts like Dakshin Kannada, Udupi, and Uttar Kannada, especially in estuary areas where country boats play a major role in the delivery of goods and services.

The bamboo and cane furniture industry seems to be a ready market for the culms, which are now being offered for Rs. 80 a piece (20 feet long). The Konkan Bamboo and Cane Centre (KONBAC), located in Kudal, Sindhudurg District, Maharashtra, has made many unique designs in home furnishings such as chairs, tables, sofa sets, cots, partitions, outdoor furniture, benches, etc. possible. In Peninsular India, they have been among the first to use *D.stocksii* in furniture manufacturing, particularly as a cane alternative. Only around 10% of the nation's need for bamboo furniture is met by KONBAC alone, which has an annual requirement of 3 lakh culms of *D. stocksii* (20 feet long). Other market participants that make significant use of *D. stocksii* include NGOs like Uravu and Waynad, as well as Bamboo Pecker, Marathahalli, Bangalore. Using *D. stocksii*, the National Institute of Design (NID), Bangalore, has also produced some cutting-edge designs for home furnishings. The availability of *D. stocksii* clumps with an average culm diameter exceeding 40 mm and a culm wall thickness to culm diameter ratio of 1:3 should further enhance the commercial potential of this species for the furniture sector. This culm dimension may prevent cracking during treatment and use and aid in better joinery. At the moment, the majority of the culms that KONBAC purchases in the Western Ghats region have a diameter of 25 to 35 mm.

Advantages

- This species has a wide adaptability comes up well in tropical humid, sub humid and semi-arid conditions.
- Non thorny nature
- Loosely spaced culms permits easy harvesting of culms and management of clumps.
- Non predominant nodes, hence may be used as substitute for cane in furniture making
- Solid culms, offer more strength and less end splitting or cracking like other hollow bamboo species.
- Self pruning of lower branches permits easiness in harvesting and processing
- Only sporadic flowering noticed, hence less chance of entire growing stock getting depleted.
- Multiple utility (edible shoots, oars by boatmen, agricultural implements, house hold handicrafts, as stakes in agriculture commodities like tomato, support/prop for banana and grape cultivation, furniture, walking sticks).
- In commercial cultivation, because of its specific culm characteristics (erect nature, less number of side branches and solid and narrow culm diameter) this species can be grown at higher density.

Disadvantages

- No seed formation, hence narrow genetic base of endemic population in central Western Ghats.
- The culm height less compared to other mid-sized bamboo species
- Vegetative propagation cumbersome since only two or three nodal culm cuttings can be used.
- Transportation of material for propagation becomes difficult due to solid nature of culms
- Variation in culm diameter limits end use potential.
- Susceptible to scale insect, rust disease during growth phase and borers to a lesser extent during post-harvest and utilization phase.
- Being very rigid, it has to be steamed to make it flexible for furniture making.

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Die-back disease of neem: An emerging issue in forest industry

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Introduction

Neem (*Azadirachta indica*) is commonly known as 'Indian Lilac', and it is one of the most versatile, multipurpose trees of the tropics. Neem is native of the Indian subcontinent and it occurs naturally in Shivalik hills, dry forests of Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra up to an altitude of 700 m (Roxburg. 1874). South Asian and sub-Saharan regions constitute the main areas of distribution. Today neem trees are found in nearly 80 countries worldwide.Its importance at global context has been enlightened by The US National Academy of Science by publishing a report entitled "Neem: A tree for solving global problems" in 1992 (NAS,1992). It is cultivated and frequently naturalized throughout the drier regions of tropical and sub-tropical India. Neem, renowned for its anti-viral, anti-bacterial and anti-inflammatory properties, is under a virulent fungal attack and the disease is spreading rapidly.Almost every part of neem *i.e.*, leaf, bark, seed, flower etc. used for making beneficial products.Neem has been shown to exhibit insect control activities against as many as 250 insect species (Anonymous 1993). More than 150 compounds have been isolated from different parts of this enigmatic tree. Neem has potential to use against plant pathogenic fungi and in the treatment of many human pathogenic fungi. The ingredients are known to have vital effects on as much as 350 species of agricultural pests. But it does not exempt the neem trees from being attacked by pests and diseases. It has become a familiar sight in Maharashtra and also in some other states over the last few years that twigs and leaves of neem trees dry up. The dieback disease was first reported in the country during the 1990s near Dehradun in Uttarakhand. The dieback is a fungal disease but the neem trees are sometimes hit by insect infestation and the combination of both increases its impact. Though neem trees are strong enough to combat the damage caused by the disease, measures to control its spread can be undertaken at community level for better results.

What is die back of neem?

Die-back of neem is serious disease caused by fungus *Phomopsis azadirachtae.*The occurrence of die-back of neem was first reported from new forests of Dehra Dun, North India (Sateesh *et al.*, 1997). It is said to be complex of pest (Tea mosquito bug) and multiple pathogen attack (*Phomopsis* and *Colletorichum* spp.) but major one is *Phomopsis azadirachtae.*The *Phomopsis azadirachtae* is a fungal pathogen responsible for causing die back disease in neem belonging to the genus *Phomopsis.* The species was first identified and described by Sateesh *et al.* in 1997.*P. azadirachtae,* the incitant of die-back on neem is a deuteromycetes fungus and seed-borne in nature.

Morphological characteristics of *P. azadirachtae*

Mycelium immersed, branched, septate, profuse, colourless, becomes pale brown later. Conidiomatais pycnidial, solitary or aggregate, half-immersed, pale brown to dark brown or black, ampulliform or sub-globose, unilocular, thick-walled, uniform throughout with the endogenous basal swelling cone with lumina of bigger cells, outer layers melanised, 300-500 µm high, up to 900 µm, wide in sections, ostiole single, unilocular, circular, papillate (Girish *et al.*, 2008).Conidiophores simple or branched, short or elongate, septate, filiform, hyaline, line the inner layer of locule, 12-20 × 1.6-2.0 µm, subulate or filiform, integrated or discrete, channel and collarette minute, hyaline, periclinal thickenings of variable thickness, 5-8 × 1.6-3 µm, The pathogen produces two types of spores i.e.Alpha(α)conidia are hyaline, fusiform, straight, 2-4 guttulate, smooth, aseptate, 4.8-11 × 1.6-3.2 µm, germinate readily, Beta(β) conidia are hyaline, filiform, eguttulate, aseptate, 16-25.6 × 1.6-2.0 µm germination unknown(Girish *et al.*, 2008).

Die back disease symptoms

- The disease symptoms include twig blight, inflorescence blight and fruit rot.
- The disease is more pronounced during August to December, though can be observed throughout year.
- Appearance of symptoms starts with the on-set of rainy seasons and becomes progressively severe in later part of the rainy season and early winter season.

Fig: Die-back disease of neem at Malegaon, Pune (PC: Dr. Sangram Chavan)

- The terminal branches are mainly affected. The disease results in the
- Twig blight is the major symptom of die back disease, also results in inflorescence blight and fruit rot resulting in almost 100 % fruit yield loss.
- Disease has been noticed in neem trees irrespective of age, size and height.Disease spreads through conidia that are disseminated by rain droplets and insects.

Integrated disease management of die-back of neem disease

Implementation of integrated disease and pest management (IDPM) programs which combine cultural, chemical, and biological approaches are highly recommended to control dieback of neem.

Cultural Control

- The pruning *i.e.*, removal of old dead twigs and branches is very important for the control of diseases. Previously infected dead shoots should be removed early in the spring before new growth begins to lessen the number of infective spores (tnau, agritech portal).
- To manage dieback disease, traditional horticultural practices have been applied to confront the fungal attack.
- In general, avoidance of wounding of trees can limit disease incidence (Alemu, 2014).
- Infected parts should be pruned from 7-10 cm below the infection site, removed, and burnt (Asrey *et al*., 2013).
- Attempts to arrest early infections have been made by treating with

progressive death of the tree, year after year (Girish *et al.*, 2008).

copper oxychloride or pasting with cow dung on pruned ends.

Biological control

B. subtilis and *P. aeruginosa* were highly effective in suppressing the growth of the pathogen.

Chemical control

- Bavistin is effective, which completely suppresses mycelial growth, sporulation and conidial germination at 0.3 ppm.
- Treatment of neem seeds with bavistin resulted in the death of the seed-borne pathogen.
- Carbendazim (bavistin) at 0.25 ppm controlled the growth of the pathogen completely. (Girish *et al.*, 2008).

Future perspectives

- Geographical demarcation of pathogens inciting die back disease of neem is necessary.
- Identification of particular genes associated with host pathogen interaction.
- Management of neem seedlings at nursery stage to maintain the vigor of tree.
- Interdisciplinary approach is necessary to study the mechanism of die back of neem in detail.
- Public awareness and area wide approach to manage both pest and pathogen causing of die back of neem.
- Use of advanced technologies to survey the actual incidence e.g., Hyperspectral Remote sensing.
- Co-operative approach among state forest and agriculture department.

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Fire ecology – The role of wildfires in forest ecosystems

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Introduction

Human beings derive a range of advantages from the effective functioning of natural ecosystems, commonly known as 'ecosystem services.' Wildfires represent a globally significant and integral aspect of numerous ecosystems, playing crucial roles in ecosystem dynamics and the preservation of species that have evolved in response to fire (Pausas and Keeley, 2009). We argue that most wildfires are natural phenomena that offer various benefits to humanity. In ecosystems dependent on wildfires, disturbance occurs when there are disruptions in the natural fire regime, often resulting from the suppression of fires or an increase in burning frequency (Keeley and Pausas, 2019). While the conservation of natural processes should not solely hinge on their utility, it is essential to reassess the services wildfires provide, particularly since they are frequently seen incorrectly as destructive disturbances.This article is aimed at analyzing the studies of how wildfires impact the main components, biodiversity, and functions of forest ecosystems. The paperanswers the question of why wildfires while beinga destructive factor, are sometimes considered a factor increasing biodiversity.

Impact on biodiversity

Wildfires impact plants both directly, by causing complete or partial destruction, and indirectly, through alterations in the surrounding environment. Consequently, short-term, and long-term effects of wildfires can be identified. Short-term effects encompass the combustion of forest fuels, such as phytomass, soil heating, burns or death of plants, loss of food sources, air quality issues, microclimate changes, immediate impact on nesting and breeding sites, terrestrial vertebrates, soil animals, and microorganisms (Geraskina, 2021). Long-term consequences include fire-induced soil transformation, loss of vegetative cover, a reduction in soil biota diversity, impaired water quality in aquatic ecosystems, changes in species composition, disruption of wildlife corridors, increases invasive species, the desiccation and demise of trees, phytomass accumulation, and postfire vegetation succession (Ivanova et al., 2018). The positive impact of wildfires on forest biodiversity is thought to involve: 1) diminished root competition among different tree species, 2) enhanced seed germination resulting from the burning of forest litter to the mineral layer, 3) a decline in the number of small mammals that may harm seeds and plant sprouts, 4) accelerated mineralization of organic matter, 5) the antiseptic effect of high temperatures on soils, and 6) reduced competition for light and precipitation on the burnt landscape.

These arguments find support in the functional losses observed in the biodiversity of contemporary forests.

These effects establish biotic relationships within forest ecosystems: the destruction of litter is facilitated by invertebrate saprophages and saprotrophic microorganisms, which also complete its mineralization, exerting a 'sanitation' effect on soils and regulating the balance of different bacterial groups. Additionally, the formation of structural diversity and the reduction of competition between plants, including underground root systems, are facilitated by zoogenic mechanisms in forest regulation (Smirnova et al., 2018).

Ecosystem services arising from wildfires are categorized into four main groups: supporting, provisioning, regulating, and cultural services, as outlined by the Millennium Ecosystem Assessment in 2005. Some of these services have received limited study, and as a result, they are introduced here as hypotheses.

Supporting services

Supporting services are typically defined as those essential to produce all other ecosystem services. One fundamental ecosystem service provided by wildfires is the creation of open habitats that facilitate the evolution of a diverse range of shade-intolerant plants and animals. Fire is likely to contribute to a range of ecosystem services, as biodiversity offers numerous benefits to humans, and fire significantly influences the variability in biodiversity. Two broad processes linked to fire—evolutionary processes (through natural selection and evolution) and ecological processes (through habitat heterogeneity)—are known to enhance biodiversity. The impacts on biodiversity from both types of processes occur because fire creates gaps in vegetation.

Fires establish new habitats with increased resources and reduced competition. Many plants have evolved diverse adaptive strategies to persist under recurrent fires and exploit the habitats generated by fire. Fire often shortens generation time and decreases the overlap between generations, promoting evolutionary novelties, especially in non-resprouting plants. While the ecological effects of fire on animals are less researched, there is growing acknowledgment that fire may influence various animal traits. At the ecological scale, fires create habitat heterogeneity by opening gaps, forming snags and deadwood patches, thereby increasing the number of potential ecological niches, and enhancing evolutionary processes. Under natural conditions, many species depend on the open habitats created and maintained by recurrent fires and grazing, with species-rich savannas and prairies serving as clear examples.

When wildfires occur, they break down organic matter and release essential nutrients into the soil, fostering the growth of new plants. They contribute to maintaining biodiversity by creating diverse habitats and promoting the growth of fire-adapted plant species. Some plant species rely on wildfires to initiate seed germination, ensuring their survival and life cycle continuation. Wildfires also help control insect populations and prevent disease spread by eliminating weak or diseased plants. The heat and disturbance caused by wildfires enhance microbial activity, facilitating nutrient cycling and organic matter decomposition. The mosaic pattern created by wildfires, with both burned and unburned patches, contributes to habitat heterogeneity, supporting a variety of species with different ecological requirements and enhancing overall biodiversity.

Provisioning services

Throughout history, wildfires have been the primary natural force responsible for creating and preserving open spaces that early human societies relied on for activities like gathering food, hunting, and later, agriculture. Presently, wildfires continue to play a vital role in supporting open grazing areas and wildlife habitats, providing advantages for recreational pursuits such as tourism and hunting. Human-initiated fire practices, like prescribed burning programs aimed at improving pastures or aiding in hunting, have replaced many traditional fire patterns. Wildfires are essential for upholding diversity and genetic variability, contributing to the production of various natural products consumed by humans.

The heat produced by wildfires could crack open seed coatings, facilitating germination and the establishment of new growth, ensuring the survival of diverse plant populations. Ecosystems prone to fire, designed to resprout following a blaze, harbor a diverse flora with underground plant structures safeguarding buds and carbohydrates below the surface. Early hominids consumed these plant resources, including bulbs, tubers, and rhizomes, potentially influencing the evolution of bipedalism(Lieberman 2014). Contemporary versions of these plant structures are commonly used in gardening and horticulture. Post-fire resprouts of specific species remain valuable in crafting materials, with tribes in Northern California utilizing hazel, willow, and beargrass resprouts (Pausas and Keeley, 2019).

An annual life cycle serves as an adaptive strategy for plants in disturbed ecosystems, with many annual food crops originating from open, fire-prone environments. Open habitats are rich in flowers, pollinators, and herbivores, leading to the evolution of various chemical compounds attracting pollinators and deterring herbivores. Some of these compounds form the basis for significant industries, including perfumes and drugs. The absence of a prolonged history of wildfires would severely limit these critical services. Additionally, dead trees and woody debris resulting from wildfires can be a source of firewood or biomass energy, contributing to local energy needs. Burned vegetation can be strategically used for erosion control measures, stabilizing soil in areas prone to erosion.

Regulating services

Ancient human societies utilized fire to clear campsites of nuisance species, and today, parasites remain a challenge for both humans and livestock. Fire has proven effective in reducing parasite loads, with evidence suggesting that suppressing fires increases the risk and transmission of infectious diseases carried by various organisms. Fire has been shown to modify host-parasite dynamics in different systems. For example, burns are currently employed to manage the spread of pest-related issues like mosquito-borne diseases. Scasta (2015) referenced 24 studies demonstrating the effectiveness of fire in managing vegetation, parasites, and disease, supporting its role as a natural control for diseases and pests affecting wildlife, forests, livestock, and human populations.

Wildfires also impact the hydrological cycle by altering vegetation structure and ground cover, influencing water runoff patterns, groundwater recharge, and overall water flow regulation in watersheds. Post-wildfire, the reduced woody vegetation significantly decreases water consumption by plants, increasing water availability in wells and springs. Reports from local farmers in Chile indicated increased stream flow after large fires in 2017, consistent with observations that burned forests are less prone to drought mortality, and surviving trees exhibit faster growth. While wildfires produce smoke and pollutants, the combustion of vegetation can clear the air of allergens, pathogens, and pollutants, contributing to improved air quality. Additionally, wildfire-generated ash enhances soil fertility by releasing nutrients, regulating nutrient cycling processes, supporting plant growth, and maintaining ecosystem health. Wildfires influence species abundance and distribution, acting as a form of natural population control and contributing to ecosystem balance.

In a warming world, wildfires may facilitate the rapid shift of plant species to more suitable environmental conditions by opening gaps, especially in non-resprouting species-dominated ecosystems. Although wildfires release carbon in the short term, they contribute to long-term carbon storage in soils by converting organic matter into stable charcoal, resistant to microbial decomposition. In regions with limited natural pollinator abundance due to a shortage of flowers, people often induce fire disturbances to enhance pollination activity by creating open spaces, where both flowers and pollinators thrive.

Cultural services

Wildfires, by fostering biodiversity and habitat diversity, create avenues for recreation and ecotourism. Notably, certain savanna ecosystems serve as ecotourism and hunting tourism hotspots. In addition to this, wildfires play a role in building traditional ecological knowledge within communities. This involves the development of insights into fire regimes, adaptive strategies, and the impact of fire on shaping ecosystems. Such knowledge opens doors for educational initiatives on ecosystem dynamics, fire ecology, and the crucial role of fire in sustaining healthy ecosystems. Furthermore, wildfires present researchers with valuable opportunities to investigate how disturbances shape adaptations and influence biodiversity, thus contributing significantly to scientific knowledge.

Conclusion

In summary, analyzing the role of wildfires in forest ecosystems is essential for devising effective strategies in fire management and conservation. Despite the apparent destructiveness of wildfires, they constitute a fundamental component of the natural cycle, playing crucial roles in sustaining the health of ecosystems. Processes such as nutrient recycling, seed germination, and the promotion of habitat diversity highlight the contributions of wildfires to the resilience and adaptability of forest ecosystems.Human intervention and fire management practices must be guided by this ecological perspective, finding a balance between safeguarding lives and property, and recognizing the ecological benefits wildfires offer. Sustainable approaches should encompass controlled burns, community education, and innovative technologies to mitigate the impact of uncontrolled wildfires while safeguarding the ecological functions that fire serves.

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Embracing wisdom from the forest man of India

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Introduction

In a world grappling with environmental challenges and deforestation, the story of Jadav Payeng, often referred to as the "Forest Man of India," serves as an awe-inspiring testament to the power of individual action in the face of adversity. Born in 1959 in Assam, India, Payeng's journey from an ordinary villager to an internationally acclaimed environmentalist is nothing short of remarkable. This article delves into the life, journey, awards, philosophy and my interaction with Padama shri Jadav Payeng, whose tireless dedication has transformed a barren sandbar into a thriving forest ecosystem.

A lifetime of extraordinary environmental dedication

Biography

Jadav Payeng was born (31 October 1959) into the Mishing tribe in Assam, a region known for its rich biodiversity. Growing up on Majuli Island, he bore witness to the alarming erosion and deforestation that were rapidly engulfing his homeland. His connection to the land and its creatures sowed the seeds of his environmental passion.Payeng, known as the "Forest Man of India," is celebrated for his remarkable work in reforesting a barren sandbar along the Brahmaputra River in Assam. His journey began in the early 1980s at the age of 19 when he was deeply moved by the sight of dead snakes on a barren sandbar after a devastating flood and he witnessed severe erosion and deforestation on Majuli Island, the world's largest river island, where he lived. This heartbreaking moment inspired him to take action and embark on a daring mission to reforest the land. With unwavering determination, he started by planting saplings despite facing numerous challenges and limited resources. Over the years, his relentless efforts gradually transformed the once-barren sandbar into a thriving forest teeming with diverse flora and fauna. To combat this environmental degradation and preserve wildlife habitat, he single-handedly planted and nurtured a vast forest spanning 1,360 acres. Today, this forest boasts a rich biodiversity, including elephants, tigers, rhinoceroses, deer, and various bird species.

Awards and recognition

Jadav Payeng's outstanding dedication to environmental conservation and reforestation has garnered widespread recognition and praise. His work underscores the significance of individual efforts in combating deforestation and habitat loss, serving as an inspiring example of one person's capacity to positively impact the environment. In 2015, Payeng received the prestigious Padma Shri, one of India's highest civilian honors, in acknowledgment of his exceptional commitment to preserving nature. The forest he nurtured with his own hands was officially named the "Molai Forest" in his honor, continuing to flourish as a testament to his enduring legacy. Payeng's inspiring journey has been immortalized in documentaries such as "Foresting Life" (2013) and "The Man Who Planted Trees" (2020), spreading his remarkable story to wider audiences. Furthermore, he has been the subject of multiple documentaries and a fictional film titled "Kaadan," "Aranya," and "Haathi Mere Saathi" (2018), directed by Tamil director Prabhu Solaman, casting Rana Daggubati. A locally made documentary, "The Molai Forest," produced by Jitu Kalita in 2012, showcased his life's work. Additionally, the 2013 documentary film "Foresting Life," directed by Indian filmmaker Aarti Shrivastava, celebrates Payeng's life and accomplishments in the Molai forest. This documentary was also the focus of William Douglas McMaster's 2013 film, "Forest Man," which received recognition and awards at various film festivals. Payeng's story has been adapted into children's books, including "The Boy Who Grew A Forest: The True Story of Jadav Payeng," written by Sophia Gholz and illustrated by Kayla Harren. This book received several awards and was translated into German and French. Another children's book, "Jadav and the Tree-Place," written and illustrated by Vinayak Varma, was also created, furthering his impact on younger generations. Overall, Jadav Payeng's remarkable journey and dedication to environmental conservation continue to inspire people around the world through various media, films, and literature.

Philosophy

Jadav Payeng's philosophy is deeply rooted in his profound love for nature and his unwavering belief in the power of individual action. His resolute declaration, "I will continue to plant until my last breath," encapsulates his lifelong dedication to the environment. His life's work exemplifies the notion that small, persistent actions can yield significant results in the fight against deforestation and habitat loss.

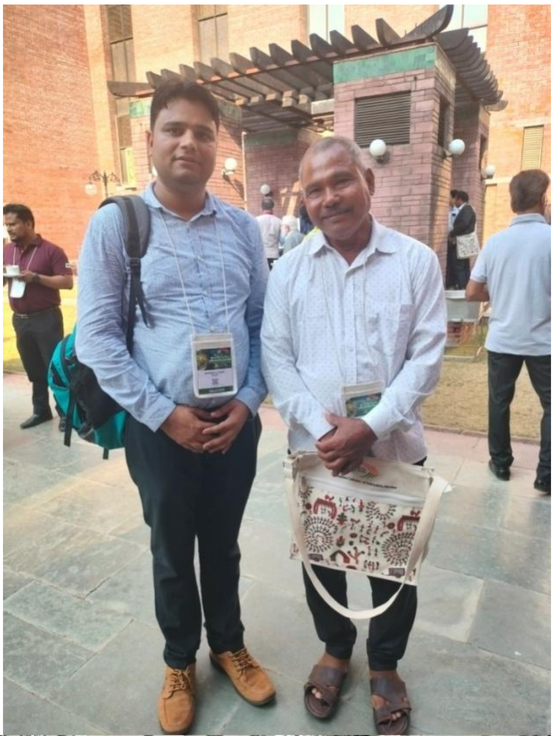

Photo: Meeting with Padama shri Jadav Payeng at the International Conference on Sustainability Education, 2023 held at Indian Habitat Center, New Delhi on 19-20th Sep 2023

My interaction

During a brief but impactful interaction with Jadav Payeng at an International conference on Sustainability Education, 2023 held at the India Habitat Centre in New Delhi, it became evident that his humility and passion were as remarkable as his reforestation efforts. Mr. Payeng shared insights into his journey, emphasizing the importance of starting small and persisting in the face of challenges. His message resonated with attendees, inspiring them to take individual actions for environmental conservation. As the conversation concluded, it was evident that Jadav Payeng's legacy would continue to motivate and guide a new generation of environmental stewards, all of whom left with a profound appreciation for his unwavering commitment to the planet.

Conclusion

The story of Jadav Payeng, the Forest Man of India, is one that transcends borders and speaks to the universal call for environmental stewardship. His life's work serves as a source of inspiration for individuals and communities worldwide, underscoring the vital role each person can play in conserving our planet. In a world grappling with environmental crises, Payeng's legacy stands as a beacon of hope, reminding us that with determination, passion, and unwavering commitment, we can indeed make a lasting difference for the Earth and its future generations. Jadav Payeng's remarkable journey will continue to be celebrated, studied, and cherished for generations to come.

मालवेसी परिवार की कुछ महत्त्वपूर्ण वनस्पतियों का सामान्य परिचय

सौरभ दुबे एवं अविरल असैया

वन सुरक्षा प्रभाग
उष्णकटिबंधीय वन अनुसंधान संस्थान
जबलपुर

मालवेसी, फूलों वाले पौधों का परिवार है, जिसमें लगभग 4225 ज्ञात प्रजातियाँ हैं । इस परिवार की कुछ महत्त्वपूर्ण वनस्पतियाँ जिन्हे हम सामान्य खरपतवार समझकर नजरंदाज कर देते है, वह औषधीय तथा अन्य रुप से हमारे बहुत काम आती है। सिडा एक्यूटा (*Sida acuta Burm. f.*), सिडा कॉर्डेटा (*Sida cordata* (Burm.f.) Borssum.), सिडा रॉम्बिफ़ोलिया (*Sida rhombifolia* L.), सिडा कॉर्डिफ़ोलिया (*Sida cordifolia*), यूरेना लोबाटा (*Urena lobata* L), यूरेना सिनुअता (*Urena sinuata* L.), हिबिस्कस लोबेटस (*Hibiscus lobatus* (J. A. Murray) O. Ktze.) प्रमुख हैं, जो बारिश तथा उसके बाद के मौसम मे भी आसानी से कठिन वातावरण मे भी पनप सकती है।

ये वनस्पतियाँ मार्गो के किनारे, खुले हुये क्षेत्रों, चारागाहों, बंजर अथवा प्रयोग मे ना होने वाले स्थलों, कृषि भूमि आदि क्षेत्रों में ऊगती हैं । आयुर्वेद में इन्हे बला, अतिबला, भूमिबला, नागबला आदि नामों से पहचाना जाता हैं। सामान्य रुप से ये वनस्पतियाँ छोटे आकार के पौधों से लेकर, छोटी झाडी के रुप मे हो सकती है, परंतु कुछ जैसे *Abitlon indicum* (Linn.) Sweet, *Urena lobata* L., *Urena sinuata* L. आदि छोटे से मध्यम आकार की झाडीनुमा पौधे के रुप मे पायी

जाती हैं। इनमें से ज्यादातर वनस्पतियों में पीले रंग के पाँच पंखुडियों वाले पुष्प आते है , परंतु

कुछ पौधों में गुलाबी तथा सफेद रंग के पुष्प आते हैं।

***Sida acuta* Burm. f**

मालवेसी परिवार के इस पौधे को सामान्य वायरवीड नाम से जाना जाता है। अंग्रेजी मे इसे ब्रूम वीड, हिन्दी मे खरेंटी / खरेंटा तथा संस्कृत – बला आदि नामों से जाना जाता है। इसकी उत्पत्ति का मूल स्थान मध्य अमेरिका माना जाता है।

यह भारत सहित अन्य उष्णकटिबंधीय इलाको में आसानी से देखा जा सकता है। यह बंजर, रेतीली व कम पानी वाली ऊसर भूमि आदि स्थानों पर आसानी से पनपती है। इसका पौधा निचली झाडी के रुप में होता है, जिसे इसकी ठोस शाखायें तथा मजबूत मूसल जड सीधा बढ़ने मे मदद करती है। इसकी पत्तियों का आकार कुछ पौधों मे अन्य की तुलना मे बडा होता है, तथा पत्तियाँ किनारों पर दाँतेदार आकृति लिये हुये होती है। पुष्पन सितम्बर से अप्रैल माह तक होता है। सामान्य रुप से इसके फूल एकल या कभी – कभी युग्म मे आते है। उपयोग – आयुर्वेद मे इसे मूत्र तथा तंत्रिका संबंधी विकारों को दूर करने सहित शारीरिक मजबूती प्रदान करने वाला माना जाता हैं। ग्रामीण क्षेत्रों में इसके झाडीनुमा पौधे को उखाडकर सुखाने के बाद समूह में बाँधकर झाडू के रुप मे इस्तेमाल किया जाता है।

***Abutilon Indicum* (Linn.) Sweet**

दक्षिण एशिया मूल के इस पौधे को थूथी या कंघी नाम से भारत के कई क्षेत्रो मे पहचाना जाता है। भारत के अलावा यह श्रीलंका मे भी पाया जाने वाला यह पौधा 2 मीटर ऊंचाई तक बढ़त ले सकता है। यह पौधा सडक के किनारे या गाँव व शहरों के खुले हुये भागों देखा जा सकता है। इसे अंग्रेजी मे कंट्री मैलो, हिन्दी मे कंघी तथा संस्कृत मे अतिबला आदि नामों से जाना जाता है। पत्तियाँ किनारों पर दाँतेदार होते हैं, जो कि बारी-बारी से व्यवस्थित क्रम मे लम्बे पत्रदण्ड से जुडी होती हैं ।

पीले – नारंगी रंग के फूल सितम्बर से जनवरी माह मे प्रमुख तौर पर आते है, परंतु बाद के महिनों मे भी अनुकूल वातावरण मिलने पर इसके फूलों का खिलना जारी रहता है। इसका गोलाकार

फल चपटे 10 से अधिक बीजकोशो से युक्त होता है। जिसकी बनावट देखने मे कंघी के समान दिखाई देती हे, जिससे इसे अपना नाम कंघी प्राप्त हुआ है।

उपयोग

एबूटिलोन इंडिकम को भारतीय प्राचीन चिकित्सा एवं यूनानी चिकित्सा पद्दति मे प्रयुक्त किया जाता है। इसमे मौजूद औषधीय गुणों के कारण इसके बीज, पत्र, पुष्प एवं जड का उपयोग विभिन्न प्रकार के रोगों जैसे, बुखार, दाँत व मसूडों, रक्त विकारों को दूर करने तथा ताकत की औषधि के रुप मे होता है।

***Sida cordifolia* L.**

संस्कृत मे बला कहा जाने वाला यह भारतीय मूल का एक बारहमासी पौधा है , जो 100 सेमी से अधिक सीधी बढ़त ले सकता है। सामान्य तौर पर पर यह निछली झाडी के रुप मे होता है। यह पौधा अधिकतर खेतो , चारागाहों, नम स्थानों आदि जगहों पर आसानी से पनपता है।

दिल आकार की इसकी पत्तियों के कारण इसे हार्ट-लीफ सीडा नाम से जाना जाता है । इसका

पौधे पर नरम सफेद रे शे हो ते है। अगस्त से दिसम्बर माह मे इस के पीले रंग के फू लों की बहुतायत का समय होता है।

उपयोग

बहुत से औषधीय गुणों से भरपूर यह पौधा शारीरिक मजबूती प्रदान करने , मूत्र विकार दूर करने के साथ – साथ हृदय संबंधी विकारों को दूर करने मे काम आता है। इसके पत्तो के रस का

उपयोग त्वचा संबंधी विकारों को दूर करने मे किया जाता हैं।

***Sida cordata* (Burm. f.) Borss. Waalk.**

सिडा कॉर्डेटा भारत का मूल निवासी पौधा है। यह भारत के उष्णकटिबंधीय और उपोष्णकटिबंधीय मैदानी इलाकों में पाया जाने वाला वार्षिक या बारहमासी पौधा हैं। इसका सामान्य नाम लॉन्ग-स्टॉक सीडा है। हिंदी मे इसे भुइनी, संस्कृत मे भूमिबला या नागबला आदि नामों से जाना जाता है। यह 50 से. मी. या अधिक बढ़त ले सकता है। पत्तियां , 1- 6.0 सेमी लंबी, दिल के आकार की होती हैं तथा इसका तना रोमयुक्त होता हैं । पीले रंग के फूल पत्ती की धुरी पर पैदा होते हैं। सामान्य रुप से अक्टूबर व

नवम्बर माह मे इसका पुष्पन होता है।

उपयोग

इसके संपूर्ण पौधे का उपयोग औषधी के रुप मे किया जाता है। जड का उपयोग त्वचा संबंधी तथा पत्तियाँ डयरिया आदि रोगो के उपचार मे किया जाता है।

***Urena lobata* L.**

यूरेना लोबाटा काष्ठीय आरोही झाड़ी या उपझाड़ीनुमा पौधा है, जिसकी ऊँचाई 1.0 मीटर से अधिक हो सकती है। इसे सामान्य तौर पर सीज़रवीड, कांगो जूट नाम से जाना जाता है । हिन्दी मे इसे विलायती सन तथा अन्य Urena burr, Hibiscus burr एवं Pink burr आदि नामों से भी पहचाना जाता हैं । यह दक्षिण तथा दक्षिण पूर्व एशिया सहित उष्णकटिबंधीय क्षेत्रों में खरपतवार की तरह आसानी से मिल जाता है। यह पौधा खुले हुये क्षेत्र या सड़क के किनारे जैसी जगहों पर आसानी से ऊगता है। कम प्रतिस्पृधि होने के कारण यह घने जंगली इलाको जैसी जगहों मे यह कम पनपता है। इसके पौधे मे सितम्बर –

अक्टूबर माह मे हॉलीहॉक जैसे गुलाबी फूल आते हैं, तथा फलों का लगना फरवरी माह होता है। फल पर छोटे – छोटे काँटेनुमा रेशे होते है, जो कि जानवरों आदि पर चिपककर इसके बीज का प्रसारण दूर तक करने मे सहायता करते है। सूखने पर इसके बीज गहरे भूरे रंग के हो जाते है।

उपयोग - यह ज्वररोधी, दाँत दर्द, तथा पेट संबंधी समस्याओं को दूर करने मे सहायक है। इसकी पत्तियों को पीसकर घाव पर लगाने से घाव ठीक होता है। ब्राजील तथा आस – पास के देशों में इसकी खेती इससे प्राप्त होने वाले फाइबर के लिए की जाती रही है।

***Urena sinuata* L.**

यूरेना सिनुअता एशियाई मूल का पौधा है, तथा यह तथा यूरेना लोबाटा बहुत समानता लिये हुये होता है।

अधिकांशत: इन दोनो को एक ही पौधा समझा जाता है। यूरेना सिनुअता भी एक काष्ठीय आरोही, झाड़ीनुमा बहुशाखीय पौधा है, जिसकी ऊँचाई 2.5 मीटर तक हो सकती है । इसे सामान्य तौर पर Bur Mallow कहा जाता है । हिन्दी मे इसे भी लपेटवां के नाम से जाना जाता हैं। यह पौधा खुले हुये क्षेत्र या सड़क के किनारे आदि जगहों पर आसानी से ऊगता है। पत्तियाँ तथा तना दोनो ही छोटे, रोम जैसे बालों से ढका होता हैं तथा इसके फूल यूरेना लोबाटा की तरह ही गुलाबी होते हैं।

उपयोग

पारम्परिक तौर इससे फाइबर एकत्र किया जाता तथा इसे सूजन दूर करने वाली औषधि के रुप मे भी जाना जाता है।

***Sida rhombifolia* L.**

सिडा रॉम्बिफ़ोलिया भारत सहित श्री लंका मे सामान्य रुप से पाने वाली प्रजाति है। इसे एरोलीफ़ सिडा, क्यूबा जूट, सहदेव आदि नाम से भी जाना जाता है। यह बारहमासी अथवा वार्षिक रुप से ऊगता है। उपझाडी के रुप मे यह 50 से.मी. से अधिक ऊँचाई के साथ सीधे तने के रुप मे बढ़ती है। पत्तियाँ तने के साथ बारी-बारी से व्यवस्थित होती हैं तथा प्रायः हीरे के आकार की और अनियमित दाँतेदार किनारों वाली होती हैं। यह प्रजाति आमतौर पर चारागाहों, बंजर भूमि, फसलों के साथ तथा सड़कों के किनारे देखी जा सकती है। फूल पत्ती की धुरी पर एकल या गुच्छों में, शाखाओं के शिरों पर आते है, जो कि पीले रंग से हल्के नारंगी रंग के होते हैं।

उपयोग

इसकी पत्तियों का प्रयोग सूजनरोधी औषधि के रुप मे किया जाता है।

***Hibiscus lobatus* (J. A. Murray) O. Ktze.)** हिबिस्कस लोबेटस एक वार्षिक पौधा है, जो कि 50 से 60 सेमी तक बढ़त ले सकता है। यह उष्णकटिबंधीय एशिया एवं अफ्रीका का मूल निवासी पौधा है। लोबेड लीफ मैलो कहे जाने इस पौधे की शाखाएँ मखमली बालों वाली संरचनाओं से ढ़की होती है। पौधे की ऊँपरी पत्तियाँ आधार पर गोलाकार, शीर्ष पर नुकीली तीन पालियो मे विभाजित होती है। सामान्यत: इसके फूलो का रंग सफेद होता है। पुष्पन तथा फलों का लगना जुलाई से नवम्बर माह के बीच मे होता है।

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Forest fire management for ecosystem restoration

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Introduction

Forest fires are not abnormal. It has always been a part of the ecology, dating back to when the planet's forests first began to grow. For healthy natural forest development and regeneration, the majority of fires are quite beneficial. Forest fires have been started and allowed to spread naturally throughout the ages. Historically, the forest floor was protected from the natural yearly accumulation of litter, such as dead trees, senescent leaves and twigs, tree needles, withered grass, and heavy undergrowth, by these low-intensity fires. Fire has therefore influenced the distribution of species and the patterns of vegetation in the forests. Not every forest experiences fire in the same way.However, depending on the vegetation type and climate, the same fire that is good for one ecosystem could be terrible for another. The places least affected by flames are tropical rainforests that are engulfed in fog and perpetually wet from mists and downpours. Because of the frequent downpours, moisture, and high relative humidity found in temperate deciduous forests, fire occurs rarely and causes minimal damage. Coniferous woodlands and evergreen forests with wide leaves are generally more prone to fire.

Components of forest fire

Fire is the naturally occurring companion of energy released in the form of heat and light, when oxygen combines with a combustible or burnable material at a suitable high temperature (about 617°F, temperature or 325°C for wood to burn). There are three components i.e. fuel, heat, and oxygen that are needed in the right combination to produce fire. A combination of these components produces the “fire triangle”. By nature, a triangle needs three sides, missing any of one side will collapse the triangle. The same is true for fire. Take away any of the three components of fire - fuel, heat, or oxygen, the fire collapses. Firefighters to suppress the fire, try to do just that and remove one of the three essential components of fire.

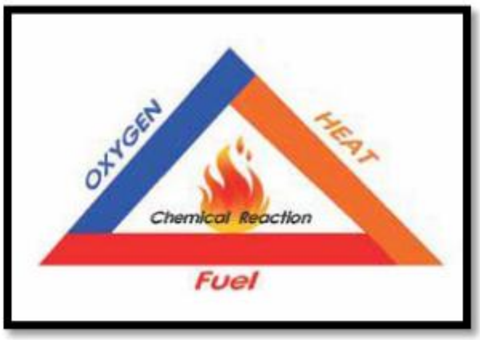

Fig.1.Forest fire triangle

Forests have been an integral part of the human ecosystem. They play a very significant role in social, economic, and religious activities and have enriched human life since ancient times. Despite their significance, forests face a myriad of challenges ranging from deforestation due to Land Use and Land Cover (LULC) changes and disturbances from fire, diseases, insects, pests, and severe weather conditions as a result of climate change. Among these factors, the incidence of forest fires has increased in recent decades and has been recognized as a major driver of the degradation of forests.

Adverse impacts of forest fire

Forest fires are a major cause of the degradation of forests/environment. Despite the lack of reliable information about forest fires, it is clear that the acreage of forest area burnt today is much more than ever before, all over the world.

1. Loss of valuable timber resources
2. Impact of forest fire on eco-system
3. Degradation of water catchment areas resulting in loss of water
4. Loss of wildlife habitat and depletion of wildlife
5. Loss of natural vegetation and reduction of forest cover
6. Global warming
7. Microclimate change
8. Soil erosion
9. Decrease in Carbon sequestration potential
10. Threat to Life and Property

Forest fire management methods

Important forest fire management elements like strategic fire centers, coordination among Ministries, funding, human resource development, fire research, fire management, and extension programs are need of the hour. There are four stages in the management of forest fires.

Prevention

In the forest manuals, working plans, and guidelines issued by the government following prevention measures are mentioned. Creation and maintenance of forest lines/fire breaks. Weed management. It is imperative to remove dried leaves to reduce fuel load, especially in the forests of Uttarakhand and Himachal Pradesh which face severe forest fire incidents every year.

Detection

Some of the detection mechanisms are as follows: Forest fire watch towers. The density of these is higher in the protected areas in comparison with the areas outside the protected areas.

Early warning system

Involvement of local people for ground-based detection depends on the acumen of the local DFOs in involving local people as informers - Regular patrolling activities which are intensified during fire seasons.

Suppression

Some of the suppression mechanisms are as follows: In addition to the traditional method such as bush beating, used for dousing forest fires, many SFDs are buying firefighting tools.

Involvement of JFMCs, EDCs, BMCs, and WMCs

Each state has its own best practices of forest fire management and working plans, which are being implemented by the govt. officials.

Post-Fire

Criteria for damage assessment post-fire vary in every state. Soil and moisture conservation measures should be taken.

Plantation of native fire-hardy species & broad-leaved species

A uniform format for Damage assessment should be made. Implementation of post-fire restoration and rehabilitation programs should be carried out Provision of plantation schemes.

Concepts of ecosystem restoration

Since these ideas have been covered in several books and publications, we will briefly discuss them with an emphasis on burned area restoration. The act of aiding an ecosystem's recovery after it has been harmed, destroyed, or degraded is known as restoration (SER 2004). Degraded or destroyed native forest ecosystems fall under this category. Restoring an ecosystem to its pre-disaster state is the goal of restoration. In the Mediterranean region, where human activity has shaped landscapes for millennia, it might be challenging to establish this baseline reference. But when it comes to burned area management, especially if our goal is to alter the sort of ecosystem that was burned, we might not even consider restoration as a goal.

Types of restoration

- Active restoration uses techniques including plantations and direct seeding. These are relatively expensive tools for restoration, as they require site preparation, equipment, manpower, seedlings from nurseries, transport to the area, fertilizers, tree shelters, etc.
- Indirect restoration implies the use of natural regeneration, and it can be either passive or assisted. Passive restoration is based on protecting the area from further disturbances and letting ecological succession work. In burned areas regeneration may occur from seeds from resprouting of burned trees and stumps or resprouting of burned shrubs or herbs. Tree resprouts, in particular, have significant advantages over seedlings or planted trees because they have an established root system which may confer a higher probability of survival and better growth Further stages in natural regeneration management imply assisted restoration and may involve thinning, the selection of shoots in coppices, and the control of unwanted vegetation or protection from grazing animals.

Framework for planning post-fire restoration

Forest and landscape managers are equipped with the means to map regions that are vulnerable to wildfires even before a fire breaks out, as well as to prioritize areas for post-fire intervention and fire prevention. Soil information, topography (particularly slope), vegetation type, and the locations of values-at-risk (important ecosystems, buildings, and infrastructure) are among the essential data needed to create these maps. These authors have mapped susceptible regions using a Geographic Information System (GIS) by a joint assessment of the vegetation's potential for regeneration and the risk of degradation (i.e., environmental factors influencing the potential for regeneration). The combination of auto succession potential—the capacity to restore the pre-fire vegetation type—and plant recovery rate—which establishes how quickly vegetation recovers to safeguard the soil and lower the risk of excessive erosion and runoff—was used to calculate regeneration capacity for various vegetation types.

Based on the erosion potential (calculated using the Universal Soil Loss Equation) and the drought risk (an approximation of the duration of the dry period), the degradation risk was calculated. In the end, the regeneration capacity and degradation risk combined to produce an ecosystem vulnerability map that made it possible to identify priority regions for post-fire action in the case of a wildfire.

Conclusion

How forests were once used is no longer applicable. Thus, it becomes crucial to develop participatory, effective plans for managing forests. Current technology needs to be assessed, and appropriate recommendations need to be made to further it while maintaining the goal of efficient fire control. It is necessary to assess the current policies and programs and create an adaptive management plan to safeguard the ecosystem. Research on scientific methods for efficient reconstruction in India's burned regions.

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Role of urban forests in carbon sequestration

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Introduction

For the first time in history, the majority of the world's population is currently estimated to reside within urban areas (UN-Habitat, 2009). This recent trend of rural-to-urban migration is one that is expected to continue into the future (Grimm *et al.*, 2008; UN-Habitat, 2009). The process of urbanization is directly associated with the two primary anthropogenic activities contributing atmospheric CO_2 levels - fossil-fuel consumption and land-use change via deforestation (Pataki *et al.*, 2006; Grimm *et al.*, 2008). Carbon dioxide (CO_2) has a very prominent role in the regulation of Earth's temperature (Hegerl *et al.*, 2006; Foster *et al.*, 2017). There has been a substantial rise in atmospheric CO_2 in the past 150 years, from 280 to 416 ppm (Krishnapriya *et al.*, 2020), owing to the industrial activities that support modern human civilization. The increasing carbon emission is of major concerns for entire world as well addressed in Kyoto protocol (Chavan and Rasal, 2010; Ravindranath, *et. al.*, 1997).

Fortunately, urban forest development can help mitigate atmospheric CO_2 levels through biological sequestration and storage, while also providing a number of other benefits to the community at large for the single cost of planting and maintaining a tree (Dwyer *et al.*, 2000; Nowak, 2006; Carreiro, 2008). These benefits include improved air and water quality (Dwyer *et al.*, 1992; Nowak, 1994; Yang *et al.*, 2005), increased opportunities for recreation, leisure, and relaxation (Dwyer *et al.*, 1992; Peckham, 2010), and reduced energy demands associated with heating and cooling of buildings (Heisler, 1986; Akbari *et al.*, 1997). As such, much interest has been directed toward how communities could better understand the urban forest as a valuable resource, in addition to exploration of strategies to optimize benefits associated with urban forest maintenance and enhancement.

Benefits of urban forests

Because the world's population continues to become more urban, there is an increasing need to understand the impacts associated with urbanization of landscapes (Grimm *et al*., 2008; UN-Habitat, 2009)

Environmental benefits

Urban trees, as major biota within urban ecosystems, have a number of direct and indirect impacts on the environment in which they grow, many of which result in the provision of valuable functions and services. Urban forests have been shown to have positive impacts on air and water quality (Dwyer *et al.*, 1992; Nowak, 1994a; Yang *et al.*, 2005; Nowak *et al.*, 2006; Nowak and Dwyer, 2007). They are also capable of reducing levels of air pollution in urban areas directly via dry deposition, and indirectly through reducing emissions associated with energy consumption (Yang *et al.*, 2005).

Stormwater runoff is a non-point source of pollution in urban areas (Duh *et al*., 2008). As such, it contains an array of pollutants that are, by their nature, extremely difficult to trace, and typically include contaminants such as lead, zinc, and excess nutrients, including nitrogen and phosphorous (Duh *et al*., 2008). Stormwater runoff subsequently degrades water quality in urban areas. Urban forests affect hydrological cycling in urban areas (Dwyer and Miller, 1999) established a positive relationship between the percentage of canopy cover and the volume and rate of stormwater runoff in a study conducted in Stevens Point, Wisconsin. They concluded if tree canopy cover is increased, pollutant loading in urban water (as is attributable to stormwater runoff) could be decreased.

Social benefits

Although social benefits provided by urban forests are difficult to assess and quantify, evidence supported by many research efforts continues to accumulate supporting the significance of direct and indirect social and psychological benefits urban forests provide to communities (Ulrich, 1984, 1986; Dwyer *et al*., 1992; Kuo and Sullivan, 2001; Peckham, 2010). Urban forests provide many opportunities for recreation, leisure, and relaxation for urban residents, most identifiably in park-like settings (Dwyer *et al*., 1992; Dwyer *et al*., 2000; Peckham, 2010), in addition to the connections people feel with the natural environment (Dwyer *et al*., 1992). Ulrich (1984; 1986) advocates that the benefits provided by urban forests contribute towards improving human health through elevating positive emotional and psychological conditions through reduction of stress and anxiety.

Economic benefits

One prevalent economic benefit associated with urban forests is savings associated with reducing energy consumption of buildings (Heisler, 1986; McPherson *et al*. 1995; Akbari *et al*., 1997, 2001; Akbari, 2002). Urban trees reduce heating and cooling demands of buildings through influencing local microclimates. When strategically placed, trees provide much-appreciated shade on a hot summer's day, and thereby contribute to negating the degree of urban heat islands (UHI). In the winter, properly planted trees block harsh and prevailing winds. Decreased energy consumption directly translates into monetary savings, but also simultaneously reduces levels of GHG emissions used to generate energy. Other economic benefits provided by urban forests include increased property and real estate values (Anderson and Cordell, 1988; Tyrväinen and Miettinen, 2000; Nowak and Dwyer, 2007), as well as improved positive consumer-merchant interactions within commercial areas (Wolf, 2003).

Carbon sequestration and storage within urban forest

Increasing concentrations of carbon dioxide in the atmosphere and its consequences on climate change have prompted a renewed interest in enhancing the carbon sequestration under different land use systems in India. Tree based land use practice could be one among the viable alternative to store atmospheric carbon dioxide due to its cost effectiveness, high potential rate of carbon uptake and associated environmental as well as social benefits (Zan *et al*. 2001; Kaur *et al*. 2002).

An account of biomass, carbon stock and CO_2 sequestration in urban forest across the world is given in Table below.

Table: Biomass, carbon stock, and CO_2 sequestration of certain urban green infrastructure of the world (t ha^{-1})

Urban forests with Locations	Biomass	Stored carbon	CO_2 sequestered	Source
Varanasi, India (urban tree cover)	4,048.79	1,904.74	6,990.51	Singh *et al*. (2022)
Varanasi, India	144.06-2327.81	72.03-1163.90	264.35-4271.54	Singh *et al*. (2023)
Urban vegetation of SargujaChhattisgarh, India	166.03–720.12	60.36–319.35	221.52–1172.03	Khan and Jhariya(2023)
Agartala, India (urban area)	90.82	45.42	166.66	Majumdar and Selvan (2018)
Chennai, India (Cooum river bank)	86.01	43.01	157.84	Majumdar and Selvan (2018)
Delhi, India (urban forest)	114.05	57.02	209.26	Ugle*et al*., 2010
Vietnam (Yok Don National Park)	158.7	79.35	291.23	Nguyen (2012)
Hangzhou, China (Industrial area)	60.5	30.25	NA	Zhao *et al*. (2010)
Leipzig, Germany (municipal area)	11.81	5.9	21.65	Strohbach and Haase (2012)
Shorewood, USA (urban community)	36.48	22.8	83.67	Dorney *et al*. (1984)
Muscat, Oman (urban area)	6050	3,000	11,100	Amoatey and Sulaiman (2020)
Darmaga, Indonesia (Bogor Agricultural University)	58.22	27.36	100.41	Lavista*et al*. (2016)
Pondicherry, India	278.22	139.11	NA	Khadanga*et al*. (2018)
West Tripura, India	11.82	5.91	NA	Deb *et al*. (2016)
Kathmandu, Nepal	548.92	214.99	NA	Dhakal *et al*. (2017)
Medan City, North Sumatra, Indonesia	218.82	100.68	NA	Rahmawaty*et al*. (2017)

Sambalpur University campus	116.08	58.04	NA	Khamari *et al.* (2021)

Conclusion

In summary, urban forests play a critical role in sequestering carbon dioxide, making them indispensable assets in the battle against climate change. Amidst escalating urbanization and carbon emissions, these green havens in cities absorb and retain substantial amounts of CO2, offering a potent solution to global warming. Beyond their aesthetic appeal and recreational value, urban forests act as crucial carbon reservoirs, bolstering the planet's ecological balance. Promoting and acknowledging the importance of urban forests isn't just integral to sustainable urban development; it's also pivotal in combating climate change and fostering resilient, eco-friendly cities for generations to come.

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Harvesting techniques: A key to promote management practices of bamboo

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Introduction

Bamboo, an evergreen woody perennial and one of the world's fastest-growing plants, serves as the backbone of the rural people's economy, generating increased interest within farming communities in the modern era (Seethalakshmi et al., 1998). In natural bamboo forests in India, the average yield per hectare typically ranges from 2.5 to 4.0 tonnes/ hectare. If the crop is handled correctly, one can anticipate roughly 6-7.5 tonnes/hectare from artificially propagated woods (Sharma 1980). Extensive research into various disciplines involved in bamboo production has led to its management in homesteads and agroforestry. To ensure optimal nutrition for healthy shoots, weak shoots must be trimmed during both the early and late stages of shooting (Maoyi and Banik 1995). Most bamboo species reach their maximal static bending and compression strength, making them ready for harvest after three to four years (Huang et al. 1993; Espiloy 1994; Banik 2015). Bamboo plantations commonly follow a harvesting cycle of 3 to 4 years, leaving a few old culms and all first-year culms, with the harvesting season typically spanning from November to January (Upreti and Sundriyal 2001). Culm harvesting is traditionally conducted during the dry winter season to mitigate borer damage. Investigation on the management of *D. strictus*, which is a close relative of *D. hamiltonii*, revealed that sustainable harvesting depends on felling intensity, cutting methods, and felling cycle (Darabant et al. 2016a). The two main justifications for Yogyakarta's custom of falling bamboo during the old season are to prevent powder post-attack from insect attacks and to end the bamboo clumps' shooting period (Suthoni 1995).

Methods of harvesting

Selective cutting

Selective cutting, described as the removal of shoots and culms with a low intensity (25% each), aims to prevent clump congestion and subsequent deterioration caused by the death of shoots near the clump's periphery (Troup 1921; Franklin 2008).

Horseshoe harvesting method

The horseshoe cut method (Tewari, 1992) was incorporated as a labour-intensive substitute that requires expertise in the correct spatial arrangement of the culms to be removed. Harvesting schedules appropriate for situation have been developed in India for *D. strictus*. The horseshoe method is extensively utilized in India and Nepal, where the convex arch of the shoe is oriented uphill to prevent dirt accumulation in the arch. With this strategy, new shoots are primarily generated on the horseshoe's outer arch, and clumps are projected to develop uphill (Bradshaw 1997). Using the horseshoe method, 75% intensity was employed to gather both shoots and culms. Horseshoe cutting, by preventing clump congestion, enhances clump vigor, leading to an increase in shoot production (Malab et al., 2006; Franklin 2008).

Clear cut method

The clear-cut method is identified as the most readily and safely executable option in unmanaged, dense clumps of *D. halmiltonii* (Nath and Das 2011). The clear-cut treatment involved the removal of 50% of new shoots and all culms older than two years. Culms were taken above the second node, resulting in a stump height of around 10-25 cm (Darabantet al. 2016b). The clear-cut method includes the elimination of dead stumps and culms, collecting culms at the base while preserving two internodes, and harvesting shoots from the inside out.

Clear-felling

In situations where culms are not harvested for a number of years, they tend to grow clogged, making clumps more vulnerable to infections and damage. Clear-felling of culms becomes beneficial for maintaining appropriate clump development and morphology, promoting clump health. Farmers in Uttarakhand (Kalinagar, Dineshpur, and Gadarpur), Bihar (Pusa), and West Bengal (Bankura) occasionally practice clear-felling in dense clumps *of B. bambos, B. balcooa,* and *D. strictus*. According to a study conducted in the Shahdol district (Prasad, 1987), clearing congested clumps and enabling new shoots to emerge is more helpful than the common method of working the congested clumps.

Challenges encountered in forest bamboo harvesting

Workers often cut more bamboo in easy-to-reach places and from young bamboo plants, ignoring the rules about how much to cut. This happens because they are paid based on how much they cut. They are tempted to collect bamboo from places that are easy to get to, like the sides of streams that always have water. This leads to using up too much bamboo in those easy-to-reach areas, and the bamboo there becomes less healthy and smaller. On the other hand, bamboo on steep slopes or in hard-to-reach parts of the forest is rarely taken, so those areas have too much bamboo that isn't being used, and the bamboo plants there are crowded and not growing well.Bamboos are typically not collected from inaccessible regions due to the mountainous terrain and difficulties in cutting and transportation. As a result, huge parts of northeast India and Myanmar, as well as other forests, have been left unexploited and underutilized for years. National highways and district roads, particularly narrow roads on hills, should be maintained and developed for better transportation of bamboo resources.

Bamboos are frequently cut 1.0-1.5 m above ground level and the upper narrow segment 1.5-2.0 m is chopped off, leaving only the mid-portion. The lower 1.0-1.5 m is heavier and has more biomass, whereas the top half of the culm has longer fiber length, which is desirable for pulp manufacturing. In most cases, these sections are left in the forest (which provides valuable raw materials to pulp and paper mills) and are not harvested. It is believed that around half of the entire length of harvested bamboo remains on the forest floor.

When clumps are cultivated on homesteads and farms in communities, old stumps and rhizomes must be removed every two years. Cutting the top parts should be avoided because it makes the culm very fragile and is bad for pulping.

Conclusion

Harvesting techniques play a pivotal role in promoting sustainable management practices of bamboo, a versatile and renewable resource. These ways are needed to make sure bamboo lasts a long time, keeps nature in balance, and brings a lot of money from using bamboo. When we use good ways to collect bamboo, it helps bamboo be a valuable plant, helping the people who live nearby and making industries like building, furniture, and crafts that use bamboo grow. We need to be careful not to collect more bamboo than can grow naturally so the environment stays healthy, and we always have bamboo to use.

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जैविक खेती में ट्राइकोडर्मा का महत्त्व

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जैविक कृषि एक ऐसी उत्पादन प्रणाली है जो कृत्रिम उर्वरकों, कीटनाशकों, विकास नियामक, और पशुओं के लिए योगात्मक चारे के प्रयोग के प्रयोग की अनुसंशा नहीं देती है। पर्यावरण, सामाजिक, और आर्थिक स्थिरता जैविक कृषि के मूल उद्देश्य हैं। भारत में वर्ष (2020-21) में लगभग 4.33 मिलियन हैक्टर भूमि पर जैविक खेती की जाती है। जैविक खेती के क्षेत्रफल तथा उत्पादन की दृष्टि से मध्य प्रदेश का भारत में प्रथम स्थान है। इसके बाद क्रमशः राजस्थान, महाराष्ट्र एवं उत्तर प्रदेश का नंबर आता है।भारत में कृषि प्रथाएं चार हजार वर्षो से भी अधिक प्राचीन हैं तथा उनमे भी जैविक कृषि देश में बहुत अधिक मूल की है। चाणक्य द्वारा रचित अर्थशास्त्र में भी वैदिक काल के किसानों में मिट्टी की उर्वरता, बीज चयन, पौध संरक्षण, बुवाई के मौसम, और विभिन्न भूमियों में फसलों की स्थिरता के उचित ज्ञान के विषय में उल्लेख किया गया है। कृषि उत्पादकता को बनाए रखने के लिए ट्राइकोडर्मा महत्वपूर्ण है।

मृदाजनित रोग फ्रयूजेरियम, पिथियम, राइजक्टोनिया, स्क्लेरोशिया, फाइटोफ्रथोरा आदि फूंफद की कुछ प्रजातियों से होते हैं, जो बीज के अंकुरण से लेकर वृद्धितक पौधे को प्रभावित करते हैं। निदान के लिए रासायनिक दवाओं का इस्तेमाल आर्थिक दृष्टि से लाभप्रद नहीं होता है। सामान्यतः फूंफद पर रासायनिक दवाओं का प्रभाव 10 से 20 दिनों तक रहता है। यदि फिर इनका प्रकोप होता है तो इन रोगों का प्रबंधन जटिल हो जाता है। लगातार रसायनों के छिड़काव और रासायनिक बीज शोधन से मिट्टी में रहने वाले लाभदायक सूक्ष्म जीवाणुओं पर विपरीत प्रभाव पड़ता है। निरंतर रसायनों के प्रयोग से रोग पैदा करने वाली फूंफदी में प्रतिरोधक क्षमता भी उत्पन्न होती है तथा रसायनों के अवशेष मानव स्वास्थ्य के लिए भी हानिकारक होते हैं।

ट्राइकोडर्मा एक फंफूद है, जो सामान्यतः मृदा में पायी जाती है। इसकी कई प्रजातियां हैं, परंतु उनमें ट्राइकोडर्मा विरडी, ट्राइकोडर्मा हारजिएनम, ट्राइकोडर्मा वाइरेन्स अधिक उपयोगी प्रजातियां हैं। यह फंफूद हरे रंग की होती है। ट्राइकोडर्मा, बीजाणुओं के रूप में कोनिडिया तथा क्लेमाइडोस्पोर उत्पन्न करता है। इनमें से क्लेमाइडोस्पोर विपरीत वातावरण में लंबे समय तक जमीन में पड़े रहते हैं। अनुकूल वातावरण मिलने पर यह क्लेमाइडोस्पोर फूंफद तंतु बनाकर वृद्धिकरते हैं तथा अधिक संख्या में कोनेडिया बनाते हैं। ट्राइकोडर्मा को यीस्ट या मोलेसेस माध्यम से उगाकर इसका कल्चर तैयार किया जाता है। इस कल्चर को कैल्शियम या चाक पाउडर में 1:2 के अनुपात में मिलाकर वैटेबल पाउडर के रूप में उन्नत कल्चर तैयार किया जाता है। इसे 100 ग्राम, 250 ग्राम, 500 ग्राम या 1 कि.ग्रा. मात्रा को कम घनत्व वाली पॉलीथीन की थैलियों में भरकर विक्रय के लिए तैयार किया जाता है। इन पैकिंगों का मानक इस प्रकार रखा जाता है कि प्रति ग्राम कल्चर में कम से कम 2x

10^8 या इससे अधिक कॉलोनी फार्मिंग यूनिट (सीएफयू)हों।

ट्राइकोडर्मा की कार्य विधि

ट्राइकोडर्मा व रोगजनकों जैसे फ्रयूजेरियम, पिथियम, राइजक्टोनिया आदि में स्थान व पोषण के लिए स्पर्धा प्रतियोगिता होती है, जिससे रोगजनकों की वृद्धिव विकास अवरूद्धहो जाता है। ट्राइकोडर्मा के फूंफद तंतु (एप्रिसोरिया), रोगजनकों के फूंफद के तंतुओं के संपर्क में आते ही उन्हें जकड़ लेते हैं। इसके फलस्वरूप रोगजनकों का विकास अवरूद्ध हो जाता है। इसके उपरांत ट्राइकोडर्मा अपने चूषकों (हास्टोरिया) को रोगजनकों के फूंफद तंतुओं में प्रवेश करवाकर उन पर अपनी वृद्धि करने लगता है। इतना ही नहीं साथ ही साथ रोगजनकों के अंदर कई प्रकार के एंजाइम जैसे-काइटिनेज, बीटा 1, 3-ग्लूकाइनेज, प्रोटिएज आदि छोड़ देता है। रोगजनक की कोशिका भित्ति नष्ट हो जाती है व रोगजनक मर जाता है। ट्राइकोडर्मा विभिन्न प्रकार के प्रतिजैविक एवं अन्य पदार्थ जैसे-ग्लियोविरिडिन, ग्लियोटाक्सिन, अल्काइल पाइरोल्स आदि भी उत्पन्न करता है, जो रोग जनकों की वृद्धिपर विपरीत असर डालते हैं। ट्राइकोडर्मा द्वारा काइटिनेज परआक्साइड जैसे पदार्थ उत्पन्न होते हैं जिस कारण पौधों में रोग के प्रति प्रतिरोधक क्षमता उत्पन्न हो जाती है। ट्राइकोडर्मा की मृदा में उपस्थिति अघुलनशील रॉकफास्फेट को घुलनशील बनाती है। इसके साथ ही वह जिंक, मैग्नीशियम, लोहा जैसे सूक्ष्म तत्वों की सक्रियता को बढ़ाती है। इस प्रकार पौधे को सकल पोषक पदार्थ उपलब्ध होते हैं। फलस्वरूप पौधों की वृद्धिऔर विकास अच्छा होता है। इसके अलावा उनमें रोगजनकों के प्रति लड़ने की क्षमता में वृद्धिहोती है

ट्राइकोडर्मा की प्रयोग विधि

बीज उपचार

बीज उपचार के लिए 6-10 ग्राम ट्राइकोडर्मा की मात्रा का प्रति कि.ग्रा. बीज की दर से प्रयोग करते हैं, लेकिन ध्यान यह देते हैं कि यह पाउडर सभी बीजों में समान रूप से चिपक जाये। यदि बीज की मात्राा अधिक है तो सीड ट्रीटिंग ड्रम में और यदि बीज की मात्रा कम है तो किसी डिब्बे या पीपे में बीज को ले लें। इसके बाद इसमें निर्धारित मात्राा में ट्राइकोडर्मा पाउडर मिलाकर अच्छी तरह हिलायें। यदि आवश्यक हो तो बीज पर 5-10 मि.ली. पानी का छींटा दें पिफर उसे 2-3 घंटे तक छाया में सुखाने के बाद बुआई करें।

पौध/पौधे के अन्य वानस्पतिक भागों का उपचार

इसका उपयोग उनफसलों, जिनमें पौध रोपण किया जाता है, जैसे-टमाटर, बैंगन, मिर्च और प्याज आदि या बीज के रूप में पौधे के वानस्पतिक भाग का उपयोग जैसे गन्ना, आलू और अदरक आदि में किया जाता है। इस विधि में ट्राइकोडर्मा की 10 ग्राम मात्रा को प्रति लीटर पानी में घोल लें। फिर इसमें रोपण के लिए तैयार पौधों की जड़ों को या पौधों के वानस्पतिक भागों को जैसे कंद, प्रकंद, बल्ब आदि को 10-15 मिनट तक डुबोने के बाद रोपण वाली फसलों को तुरंत रोपित करें। वानस्पतिक भागों को थोड़ी देर छाया में सुखाने के बाद ही खेत में बुआई करें। पौध उपचार के लिए 10 ग्राम ट्राइकोडर्मा पाउडर को एक लीटर पानी में मिलाकर इस घोल से पौधे की जड़ों को नम करें।

नर्सरी उपचार

इस विधि का उपयोग मुख्यतः सब्जी वाली फसलों के लिए किया जाता है, जिनकी पहले हम नर्सरीतैयार करते हैं। फिर इनका रोपण खेत में करते हैं। पौधशाला उपचार के लिए 250 ग्राम ट्राइकोडर्मा पाउडर को 50 लीटर पानी में घोलें व इस घोल से 400 वर्गमीटर क्षेत्रा की पौधशाला की क्यारी को झारा या फव्वारा के माध्यम से तर कर दें या 250 ग्राम ट्राइकोडर्मा पाउडर को 2-2.5

कि.ग्रा. सड़ी हुई गोबर की खाद में मिलाकर 400 वर्गमीटर क्षेत्र की पौधशाला (क्यारी) में छिड़ककर इसकी हल्की गुड़ाई कर मिट्टी में मिला दें।

मृदा उपचार

मृदा उपचार के लिए 2.0-2.5 कि.ग्रा. ट्राइकोडर्मा पाउडर को 75-80 कि.ग्रा. पकी हुई गोबर की खाद में मिलाकर 10-15 दिनों के लिए किसी छायादार स्थान में रखकर उसे जूट के बोरे से ढक दें। ध्यान रखें कि उसमें पर्याप्त नमी बनी रहे। बुआई की अंतिम बखरनी के समय उपरोक्त मात्रा को प्रति हैक्टर की दर से बुरकाव करें।

खड़ी फसल में छिड़काव

खड़ी फसल में फूंफदजनित रोगों के लक्षण प्रकट होने पर इनके प्रबंधन के लिए 6-8 ग्राम ट्राइकोडर्मा को प्रति लीटर पानी में मिलाकर छिड़काव करें।

प्रयोग में सावधानियां

- यह क्षारीय भूमि में कम असरकारक है।
- इसके प्रयोग के समय मृदा में पर्याप्त नमी होनी चाहिए।
- इसके उत्पादों को विश्वसनीय स्त्रोतों से ही खरीदें।
- इसके उत्पाद प्राप्त करने से पूर्व सुनिश्चित कर लें कि इसे धूप एवं अधिक तापमान में तो भंडारित नहीं किया गया।
- इसे खरीदने के पश्चात तुरंत इस्तेमाल करें। परंतु यदि भंडारण की आवश्यकता हो तो इसे नम व छायादार स्थान पर ही थोड़े समय के लिए भंडारित करें।
- वांछित परिणाम प्राप्त करने के लिए उचित सांद्रण का प्रयोग करें।
- प्रयोग से पूर्व पैकेट में अंकित सभी जानकारियां भलीभांति पढ लें।

- **सीमायें**
- इसके उपयोग के बाद 4-5 दिनों तक रासायनिक कवकनाशी का उपयोग न करें।
- सूखी मृदा में ट्राइकोडर्मा का प्रयोग न करें, क्योंकि इसकी बढ़वार व जीवित रहने के लिए नमी बहुत आवश्यक है।
- ट्राइकोडर्मा उपचारित बीज को धूप में न रखें।
- इससे उपचारित गोबर की खाद को ज्यादा समय तक न रखें।

ध्यान देने योग्य बिंदु

- कल्चर में पर्याप्त मात्रा में सी.एफ. यू. (कॉलोनी फार्मिंग यूनिट) होनी चाहिए।
- सही समय पर ट्राइकोडर्मा का उपयोग करें, जिससे हानिकारक फूंफद को यह समय से रोक सके।
- कल्चर का फसल पर सही असर कल्चर उत्पादन तिथि से छः महीने के अंदर उपयोग करने पर होता है।

आधुनिक कृषि में किसान फसलों में मृदाजनित व बीजजनित रोगों की रोकथाम के लिए केवल रासायनिक फूंफदनाशक दवाओं पर ही निर्भर हैं। विभिन्न प्रकार की समस्यायें जैसे प्रदूषण इससे लगातार एक ही फूंफदनाशक दवा के उपयोग से रोगनाशकों में उसके प्रति प्रतिरोधक क्षमता और उत्पादन लागत में वृद्धि आदि उत्पन्न होती हैं। फसलों में होने वाले रोगों की रोकथाम के लिए रासायनिक फूंफदनाशकों के साथ-साथ जैव फूंफदनाशकों का भी उपयोग करें, जो न केवल हमारे स्वास्थ्य व पर्यावरण के लिए सुरक्षित है बल्कि आर्थिक दृष्टिकोण से भी लाभदायक है।

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