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Van Sangyan

Note to Authors:

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

by e-mail to vansangyan_tfri@icfre.org

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

The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number. TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

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

From the Editor's desk

Feeding is one of the most basic behaviors for survival of an individual animal and for the species. Animals must ingest chemicals necessary for energy production, for maintenance of biochemical processes, and for growth and development. At the same time, they should reject foods that contain toxic or useless compounds. Insects as a group feed on a great variety of materials, such as animal or plant tissues or dead organic matter. Despite this unique ability to utilize almost any organic substrate, most insect species restrict themselves to a particular category of food. Some insects even specialize on a certain plant or animal species. This variety in feeding habits that we see today is the result of anatomical and physiological adaptations to food sources that are not all equally beneficial to the insect. Food selection is therefore of paramount importance to the survival of the individual. The physiological need for food by insects varies constantly due to changing factors such as nutritional state, food deprivation, developmental state, and food experience. Therefore, the study of insect feeding has attracted many students of animal behavior using different approaches, from neurophysiology to evolutionary biology. Insects comprise about 75% of all animal species on earth. About one-half of this group uses living plants as their food, whereas the other half feeds upon dead plant material or upon animals, both dead and alive. Four major classes of feeding habits are recognized: plant feeders, predators, scavengers, and parasites. Within each of these classes, various types of feeding can be found: biting and chewing on leaf or animal tissues and sucking from plant or animal cells or tissues.

Insect predators consume mainly other insects and are found predominantly in the orders Odonata, Mantodea, Heteroptera (Reduviidae and others), larval Neuroptera, Mecoptera, Diptera (Asilidae and Empididae), Coleoptera (Adephaga and Coccinellidae), and Hymenoptera (Sphecidae and Pompilidae. Biting and sucking are the two types of feeding found among predator species. Ectoparasites feed by sucking or biting on their host while residing on the outside of their prey. Examples are found in the Siphonaptera, Anoplura, Mallophaga, some Dermaptera, Heteroptera, various Diptera (such as mosquitoes), Simuliidae, Ceratopogonidae, Tabanidae, and the Pupipara. Saprophagous insects are scavengers that feed on dead or decaying organic material. These insects are found in many orders-for example, in the Blattodea, Isoptera, Coleoptera, and Diptera. Insects with this feeding habit will not be further discussed because there is a general lack of information on control mechanisms. Most insects obtain sufficient water with their food. However, some drink water, especially if they are dehydrated. Water intake and its control are discussed here only in the larger context of regulation of feeding.

In line with the above this issue of Van Sangyan contains an article on Insect feeding mechanism and their management. There are also useful articles viz.. नई तकनीक से धान की खेती – बुआई से कटाई तक, *Man-animal conflict and coexistence and Nature talks about man-made forests: (Miyawaki method), जैविक-जलनिकास (बायोड्रेनेज): जल संरक्षण हेतु सर्वश्रेष्ठ विकल्प, Silkworm as human food and Wind disaster: A threat to rubber plantations of Tripura.*

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

Looking forward to meet you all through forthcoming issues

Dr. Pawan Rana
Scientist 'E' & Chief Editor

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Insect feeding mechanism and their management

Shailendra Bhalawe*, Rishikesh Thakur, Uttam Bisen, Prashant Shrivastava Dhananjay Kathal and Ajay Singh Lodhi

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Introduction

Feeding is the important process by which all insects obtain their food in adequate quantity. In search of evolution of insect feeding, it is varied with different strategies evolved at several times in independent lineages (Sahney *et al*., 2010). Insects and also mites that feed on plants have different feeding behaviours, include biting and chewing (e.g. grasshoppers), piercing and sucking (e.g. sap feeders), rasping and sucking (e.g. thrips), Chewing and lapping (e.g. honey bees), siphoning (e.g. moths and butterflies) etc. Thereby they cause variety of symptoms on plants such as formation of galls (Fig.1), leaf twisting (Fig. 2), leaf cupping (Fig.3), leaf mines (Fig.4), leaf skeletonization (Fig. 5), wilting and rotting. Differently, biting and chewing insects, physically remove portions of any of plant tissues either directly or consume entire plant parts and ingest macerated tissues. All insects that possess other methods of food ingestion are known to be evolved from these two types. Common examples for insects with piercing and sucking and related types of mouthparts include plant bugs, aphids, whiteflies, mealybugs, scales, hoppers and thrips cause severe defoliation and significant yield loss (Fig. 6 to 8). They thrust their flexible stylet or proboscis into the vascular tissues of plants either in xylem or phloem and acquire sufficient quantity of plant sap. This resulted in variety of malfunctions and deviations in phenology and physiology of plant system. Majority of sap feeders concentrate on phloem (main transport channel of food materials) to obtain their nutrition and whereas, certain leafhoppers and spittlebugs feed within the water-conducting tissues called xylem.

Feeding mechanism

Basically, any insect possesses following parts such as, upper lip (labrum), lower lip (labium), cutting parts (pair of mandibles), holding and mastigating structures (pair of labia) and a middle hypopharynx in their mouth either with or without modifications. In due course of evolution, sap feeders evolved with some essential modified adaptations to ingest food. Majority of sap feeding insects passively uptake their food from vascular tissues via high pressure exist within sieve elements. Their mouth parts such as maxillae and mandibles are elongated into thrusting stylets which pierce the plant tissues. Whereas, the distal end of labium act as feeding guide for stylet. While feeding, these insects known to produce saliva contain digestive enzymes of plant tissues (Miles 1999, Felton and Eichenseer 1999). This feeding habit cause only little damage to plant cells when compared to that of chewing Insects. In order to recognize ideal host plants, the sap feeders normally make multiple feeding probes through their stylet (Alvarez et al., 2006; Schwarzkopf et al., 2013).

Host plants and insect feeding

Majority of sap feeders' harbours on green tissues of plants and also devastate reproductive portions during certain conditions. It is mainly attributed to the presence of relatively high levels of protein. Nitrogen is the primary plant nutrient influence on host plant nutrition. It also contributed to the production of certain defensive secondary metabolites which may interfere with acceptability. In general phloem vessels are chief transport source of all plant nutrients and xylem take care of movement of water. Insects those feed on phloem vessels (e.g. aphids, mealybugs, scales, whiteflies) are found to be predominant than on xylem feeders such as cicada, spittle bugs, leaf hoppers (Wiegart, 1964, Bayers and Wells, 1966, White, 1976, David and Robert, 1987). Xylem feeding insects tends to be adjusted with more negative water tension and very low concentrations of essential nutrients available in xylem vessels resulted in extraction of large quantities of plant fluids than phloem-feeders. But this is not easy process as sap feeders need to exhibit many physical and chemical reactions to overcome plant defences exerted though their secondary metabolites (Guerrieri and Digilio, 2008). Similarly, plant nutrients are highly accumulated in reproductive portions than the vegetative arts such as leaves and stems and this varied depend on plant type, age and nutritional status of the soil. Excessively fertilized plants produce succulent growth and thinner cuticles which causes their more susceptibility to sap feeders through easy penetration of stylets and rapid food ingestion. Insects such as aphids, mealybugs, whiteflies, scales and certain hoppers feed on phloem excrete larger quantities of honeydew rich in sugar and amino acids and this could be achieved by consumption of large quantities of plant sap. On the other way, this helps them for good development and reproduction. As a chain of reaction, black sooty mould often grows on honeydew deposited by sap feeders. Phloem feeders possess appreciable number of enzymes like amylase, protease and lipases which help to break down the plant tissues. In addition, their host preference and suitability are decided by plant-specific chemical compounds. Sap feeders known to harbour many intracellular symbiotic microorganisms for efficient digestion and utilization of food (Douglas, 2006). Apart from direct feeding and causing quality deterioration their infestation is associated with the transmission of phytopathogenic viruses (Fig. 9). Thrips often referred as an important sap feeder, known to lacerate the plant tissue instead of cutting due to absence of right mandible. This was achieved by the aberration action of their left mandible against the plant and sucking part helps them to take the liquefied plant tissue. Mites especially red spider mites and yellow mites do not feed in the vascular tissues instead feed on under surface of leaves and obtain food by removing chlorophyll with their stylet like structure called as chelicerae (Fig.10). Due to this kind of feeding nature they are not much susceptible to systemic insecticides.

Suitability of insecticides

As sap feeders directly ingest the plant sap, insecticides possessing systemic action are found to be more promisive to manage them. Basically, systemic insecticides are classified as plant systemic (systematically moved in plants alone), insect systemic (systematically translocated in insect alone) and plant and insect systemic (translocated in both plants and insects). Majority of the commercial

plant systemic insecticides upon absorption through leaves in turn translocated in xylem vessels followed by acropetally (upward) moved along with water and nutrients and hence they are referred as one-way systemic. Insects with piercing-sucking mouthparts that derive nutrients from food conducting vessels are susceptible to systemic insecticides. Plants do not readily metabolize these systemic insecticides. They possess greater water solubility which allows them to be distributed throughout plant system.

Fig 1

Fig 2

Fig 3

Fig 4

Fig 5

Fig 6

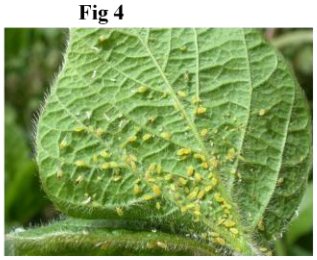

Fig 7

Fig 8

Fig 9

Fig 10

Generally, the active ingredient (A.I.) is taken up and moved throughout the plant via xylem, phloem or both and as a result the whole plant sap becomes insecticidal. As an insect feeds, it takes up a lethal dose of A.I. and cause killing of insects. Insects with piercing-sucking mouthparts that feed primarily on the underside of leaves are susceptible to insecticides with translaminar properties or local systemic activity viz., abamectin, acephate and spinosad. Howbeit, phytophagous mites are susceptible to insecticides or acaricides with translaminar properties such as abamectin and etoxazole. In order to achieve desirable level of management, while targeting insects feed on xylem, the systemic insecticide should be xylem translocative and similar concept has to be adopted for phloem feeders also.

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नई तकनीक से धान की खेती – बुआई से कटाई तक

शाहिना परवीन एवं निशार अख्तर

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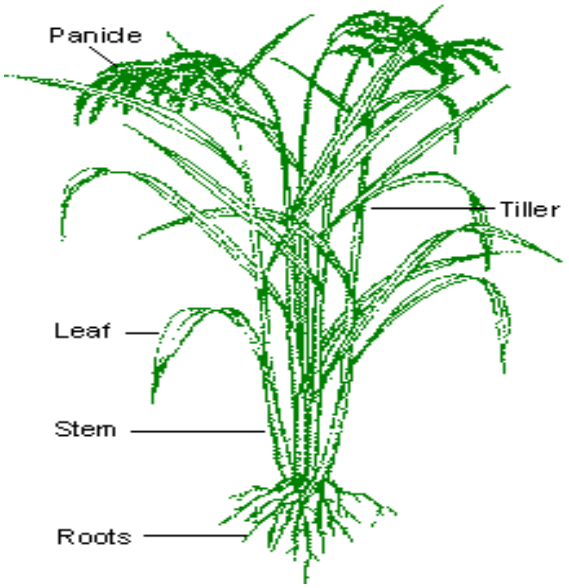
परिचय

दुनिया भर मे धान की खेती हर साल लगभग 44.2 मिलियन हेक्टेयर एरिया मे किया जाता है । धान दुनिया की आधी आबादी का मुख्य आहार है , इसकी खेती लगभग 5000 ईसा पूर्व पुरानी है। माना जाता है कि धान की खेती की कम से कम 140,000 से अधिक किस्में मौजूद हैं । औसत एशियाई व्यक्ति की सालाना धान की खपत 150 किलो है और यूरोपीय व्यक्ति की औसत खपत 5 किलो है। पृथ्वी पर प्रत्येक व्यक्ति के लिए वार्षिक रूप से औसत 65 किलो धान तैयार किया जाता है। कई एशियाई भाषाओं में 'फीड/भोजन' और 'चावल' के लिए समान शब्दो का इस्तेमाल किया जाता है । झारखंड मे अकेले धान कि खेती पूरे कृषि युक्त भूमि का 70% एरिया मे की जाती है। झारखंड मे कृषि युक्त भूमि 26 लाख हेक्टेयर है जिसमे अकेले खरीफ धान 18 ला ख हेक्टेयर मे की जाती है। झारखंड मे धान कि औसतन उत्पादकता 1.2 टन प्रति हेक्टेयर होता है।

धान के लिए जलवायु और मिट्टी

धान मुख्यतः उष्ण एवं उपोष्ण जलवायु की फसल है इसकी खेती के लिये चिकनी और बलुई मिट्टी सर्वोत्तम मिट्टी मानी जाती है क्योंकि उनमें पानी को रोकने की क्षमता होती है। इसकी खेती मे पोषक तत्वों के लिए मिट्टी का अधिकतम पीएच 5.4 और 6.2 के बीच होना चाहिए । पोषक तत्व के रीसाइक्लिंग उद्देश्य के लिए आदर्श C: N (कार्बन: नाइट्रोजन) अनुपात 20 से 30:1 की सीमा में होता है।

धान के पौधा के मुख्य भाग



जड़

ये मिट्टी से पोषक तत्वों को सोख लेता है जो पौधा के विकास मे सहायक होता है इसलिए जितनी ज़्यादा जड़ होगी उतना ज़्यादा पोषक तत्व पौधा को मिलेगा जिससे विकास बहुत ज़्यादा होगा ।

तना

इसका कार्य पोषक तत्व को पत्तो तक पहुचाना होता है और पौधे को मज़बूत बनाये रखना है।

पत्ता

इसको पौधा का रसोई कह सकते हैं क्यूंकि ये पौधा के लिये भोजन बनाता है।

टिलर

पौधा मे जितना ज़्यादा टिलर निकलता है उस पौधा मे ज़्यादा बाली निकलता है और उपज बढ़ जाता है।

बाली या पैनिकल

ये पौधा का प्रजनन भाग है जहां पे फूल से दाना बनता है।

धान बढ़ने के चार चरण

छोटे पौधे

इस चरण मे पौधा मे तीन से चार पत्तिया होती है।

वानस्पतिक

ये धान के पौधे के लिये सबसे महत्वपूर्ण चरण होता है क्यूंकि इसमे पौधे का विकास सबसे ज़्यादा होता है।

पुनरुत्पत्ति

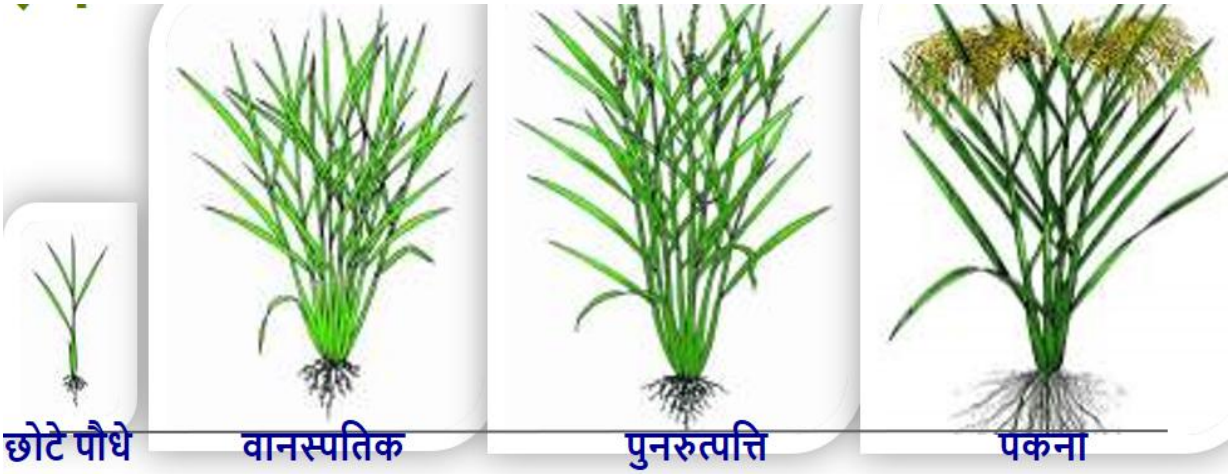
धान के पौधे के इस चरण मे बाली निकलने से लेकर दाना बनने तक का कार्य होता है।

पकना

जब दाना पूरी तरह से तैयार हो जाता है तो इस चरण को धान का पकना कहते हैं।

सारणी 1 – धान के चार चरण

फसल के चरण	जल्दी (105-125 दिन)	मध्यम (125-140 दिन)	लंबे (150 दिनों से अधिक)
छोटे पौधे	20	20	20
वानस्पतिक	~20-40	~45-60	~65
पुनरुत्पत्ति	35	35	35
पकना	30	30	30



उपज के लिए योगदान देने वाले पौधे के पैरामीटर

किसी भी फसल की उपज के लिए कुछ ऐसे पैरामीटर या कारक होते हैं जिनका योगदान पौधों में बहुत होता है धान के उपज में योगदान देने वाले कुछ महत्वपूर्ण पैरामीटर इस प्रकार हैं:

1. पौधों की संख्या (हिल्स की संख्या) प्रति क्षेत्र इकाई
2. प्रति हिल पैनिकल्स की संख्या
3. प्रति पैनिकल अनाज की संख्या
4. 1000 अनाज का वजन (टेस्ट वेट)

उपज फार्मूला

उपज (t/ha) = P x G x W x 10^{-5}

P = प्रति वर्ग मीटर पैनिकल की संख्या,

G = प्रति पैनिकल दाने की संख्या

W = प्रति 1000 दानों का वजन

उत्पादकता की बाधाएं

कुछ ऐसी बाधाएं होती हैं जो किसी भी फसल के उपज को सीधे या किसी और तरीके से प्रभावित करती हैं ।इन बाधाओ को दो भागो में विभाजित किया गया है, आंतरिक बाधाएं और बाहरी बाधाएं। ये बाधाएं कुछ इस प्रकार हैं:

आंतरिक बाधाएं

1. बीज की खराब गुणवत्ता
2. खराब नर्सरी प्रबंधन
3. पौधों का कमजोर होना
4. जमीन का खराब प्रबंधन
5. खराब जल प्रबंधन
6. खरपतवार, कीट और रोग का खराब नियंत्रण
7. इनपुट को समय पर नहीं डालना

बाहरी बाधाएं

1. पोषक तत्वों का असंतुलन
2. मौसमी बदलाव - बाढ़ / सूखा / तनाव
3. समय के बाद कटाई -दाने बिखर जाना

धान की खेती दो बिधियों से की जाती है

1. नर्सरी करके धान की खेती तथा "रोपाई बिधि"
2. बीज बुआई करके धान की खेती

नर्सरी करके धान की खेती तथा "रोपाई बिधि"

इस विधि में धान कै बिज़ को नर्सरी बेड तैयार कर के बोआ जाता है। जब पौधा 20 से 25 दिन का हो जाता तब उसको मुख्य खेत मे रोपाई किया जाता है। ज़्यादातर किसान इसी विधि से धान की खेती करते हैं।

बीज बुआई करके धान की खेती

इस विधि मे सीधे बीज़ की बुआई मुख्य खेत मे किया जाता है। इसमे किसी भी प्रकार की नर्सरी करने की ज़रुरत नही होती है । बीज़ की बुआई मुख्य खेत मे दो तरीके से किया जाता है, ये दो तरीके निम्न प्रकार के है:

धान की बीज को अंकुरण करके कादो जमीन में सीधी बीज बुआई

जहाँ पे सिंचाई की सुविधा उपलब्ध हो उसी क्षेत्र में इस विधि से धान की खेती की जाती है। इस विधि मे जूट के बोरे में धान के बिज़ को नम कर के अंकुर आने तक 2 से 3 दिन छोड़ दिया जाता है उसके बाद खेत मे कादो कर के ड्रम सीडर से अंकुरा हुआ बीज़ की बुआई कर दी जाती है।

सूखा बीज को सूखा जमीन मे बीज बुआई

यह धान लगाने का एक तरीका है जिसमे लाइन से कम दिन का (90 से 120 दिन) धान की बोआई की जाती है। इस तरीका में कादो करने, नर्सरी करने एवं धान का रोपाई का जरुरत नही पड़ता है, लाइन से बोआई के लिए 5 फाल वाले मार्कर का प्रयोग किया जाता है एवं निकाई कोड़ाई के लिए व् मशीन का प्रयोग होता है। इस तरीके से धान लगाने में वर्षा के ऊपर निर्भरता कम हो जाती है, मजदूर कम लगता है तथा साथ

ही साथ आगात रबी फसल भी कम पानी में उगाना आसान हो जाता है। इस तरीके खाद भी लाइन से दिया जाता है एवं मशीन से कोड़ाई करने के कारन खेत में घास का दिक्कत कम होता है।

धान की खेती के लिये चार प्रमुख घटक

1. फसल का चुनाव
2. भूमि की तैयारी
3. फसल उगाना
4. फसल देखभाल और वृद्धि

फसल का चुनाव

उपयुक्त किस्म का चयन

बाज़ार के अनुकूल दाने की अच्छी गुणवत्ता वाले फसल उत्पादन को सुनिश्चित करने के लिए स्थानीय तौर पर अनुकूलित किस्म का चयन करना चाहिये इस किस्म के बीज़ मे पाए जाने वाले गुण इस प्रकार हैं, बाज़ार/ग्राहक की आवश्यकता के अनुकूल स्वीकार्य दाने की गुणवत्ता, स्थायित्व के साथ सीजन पर पर्याप्त उत्पादकता, लॉजिंग के लिए प्रतिरोधक क्षमता, फसल उगाने के स्थानीय तरीकों के लिए उपयुक्त और सीजन के अनुसार वृद्धि होना चाहिए।

बीज दर और अंतराल

अलग अलग अवधि वाले किस्मो का बीज़ दर एक जैसा नही होता है, बीज़ की मात्रा भिन्न होती है।

- कम अवधि (105-125 दिन): 6 से 25 किलो / एकड़
- मध्यम अवधि: (125 -140 दिन) 6 से 16 किलो / एकड़
- लंबी अवधि (150 दिनों से अधिक) 6 से 25 किलो / एकड़
- हाइब्रिड (110-140 दिन): 5 से 7 किलो / एकड़
- एस आर आई विधि: 3.2 किलो / एकड़

धान नर्सरी प्रबंधन

खरपतवार प्रबंधन

- बीज बोने के पहले अंकुरण से पूर्व 1-3 दिन बाद 500 वर्गमीटर पर 75 मिली सोफिट डाला जाता है।
- शाम के समय 5-7 किग्रा सूखी बालू और संतृप्त मिट्टी में सोफिट मिलाकर छिड़काव किया जाता है।

उर्वरक प्रबंधन

आधार खुराक

FYM 350-400 किलो (गीली जुताई), यूरिया 1.0 किलो, DAP- 3.0 किलो, MOP- 2.5 किलो, जिंक - 50 ग्राम का प्रयोग किया जाता है।

टॉप ड्रेसिंग (15 DAS)

यूरिया: 2 किलो FYM 350-400 किलो (गीली जुताई), जिंक (जिंक ऑक्साइड) 2% छिड़काव किया जाता है।

भूमि की तैयारी

भूमि की आरंभिक तैयारी के लिए पानी की बचत

करने के लिए गर्मियों के दौरान भूमि पर हल चलायें हल चलने से 1 या 2 दिन पहले खेत में पानी भरें और जमीन को सोखने दें। खेत की सतह

के पानी के साथ कवर रखें गीली जुताई के समय जल का स्तर 2.5 सेमी रखें खेत की स्थिति के आधार पर विभिन्न प्रकार के जुताई के उपकरणों का इस्तेमाल करें।

भूमि को समतल करना

भूमि का समतल करना अत्यंत ही आवश्यक होता है। अगर भूमि कों समतल नही किया जाये तो फसल को विभिन्न तरीको से प्रभावित करता है। हर 10 मिमी सतह भिन्नता के लिए, प्रति हेक्टेयर 260 किलो की फसल हानि होती है। भूमि समतल करने पर खरपतवार 40% नियंत्रित हो जाती है। खेती का क्षेत्र 5% से 7% के बीच बढ़ जाता है। खेतों को नया आकार देने से ऑपरेटिंग समय 10% से 15% तक कम हो जाता है । लेवलिंग/भूमि समतल करने से ट्रांसप्लांटिंग और सीधे बीजरोपण में लगने वाला समय कम हो जाता है। एशियाई चावल के खेतों की औसत परिवर्तनशीलता 160 मिमी है । इसका मतलब यह है कि पानी के पूरे कवरेज लिए क्षेत्र में अतिरिक्त 100मिमी पानी संग्रहित किया जाना चाहिए।

फसल उगाना (फसल लगाना)

ट्रांसप्लांट/ प्रतिरोपण

अच्छे पौधरोपण और अधिक खेती के लिए 3-4 पत्तों के अंकुरित पौधों का उपयोग करें। हाथों से प्रतिरोपण करने के लिये 20 दिन की अंकुरित पौध और यांत्रिक विधि से प्रतिरोपण करने के लिये 15 दिन पुरानी पौध सबसे उपयुक्त होती है । एक स्थान पर 1-2 पौध को लगाएं और उपज के लिए रेडिएशन को कम करने के लिए पूर्व-पश्चिम दिशा में प्रतिरोपण करें कम गहराई वाले पौधरोपण (3 सेमी) तत्काल रुपाई और अधिक टिलर को सुनिश्चित करता है । सीडलिंग को बाहर निकालकर ट्रांसप्लांट 30 मिनट के भीतर और बीच के अंतराल को रोपाई के 7-10 दिन बाद भरा जाता है। रोपाई के लिये अलग अलग अवधी वाले किस्मो की दूरी भिन्न होती है जैसे कि कम अवधि: 20x10 सेमी, मध्यम अवधि: 20x15 सेमी, लंबी अवधि: 20x20 सेमी, यांत्रिक प्रतिरोपण : 30 x 18 सेमी और SRI विधि : 25 x 25 सेमी।

जल प्रबंधन

विभिन्न धान के चरणो मे पानी की आवश्यकता अलग अलग मात्रा मे होती है जो की नीचे सारणी- 2 मे दिया गया है तथा खेत मे पानी की गहराई भी अलग अलग होती है जो सारणी 3 मे दिखाया गया है। सक्रिय जुताई चरण या खेत की तैयारी के समय मे पानी पर्याप्त ना होने पर 30% उपज का नुकसान होता है । पौधरोपण की बिजाई से लेकर फूल लगने तक का चरण मे पानी पर्याप्त ना होने पर 60% उपज का नुकसान होता है।

पोषण प्रबंधन

धान के पौधे पर सारे पोषक तत्वो का प्रभाव अलग अलग पड़ता है इन पोषक तत्व का पड़ने वाले प्रभाव इस प्रकार हैं:

नाइट्रोजन

N (नाइट्रोजन) जैव ईंधन उत्पादन को बढ़ाता है, उत्पादन घटक में योगदान देती है, पत्तियों को पकने में विलंब करता है और दानों और प्रोटीन सामग्री को भरता है। इस की कमी से तने में वृद्धि नही होती है, पुरानी पत्तियां या संपूर्ण पौधे में पीलापन आ जाता है, नई पत्तियों को छोड़कर सभी पत्तियां संकरी, छोटी, सीधी, और

सारणी 2 – धान के विभिन्न चरणो के अनुसार पानी की मात्रा (मि.मि)

चरण	पानी की आवश्यकता (मिमी)
नर्सरी	40
मुख्य खेत की तैयारी	200
पौधरोपण से लेकर पैनिकल की बिजाई तक	458
पौधरोपण की बिजाई से लेकर फूल लगने तक	417
फूल लगने से परिपक्व होने तक	125
कुल	**1240**

सारणी 3 - धान के विभिन्न चरणो के अनुसार पानी की गहराई (से. मि)

चरण	पानी की गहराई (सेमी)	पाने के स्तर को बनाये रखने का कारण
प्रतिरोपण पर	2-3	• उथले बीज रोपण से अधिक जुताई
प्रतिरोपण के बाद जुताई	5	• अंकुरित पौधों की बेहतर स्थापना • नई जड़ों का त्वरित विकास • वाष्पोत्सर्जन में कमी
जुताई के दौरान	2-3	• जड़ को अधिक प्रोत्साहन • अधिक टिलरिंग से उत्पादन अधिक होता है और बाद में पैनिकल
पैनिकल से लेकर फूल लगने तक	5	• पैनिकल की वृद्धि-लंबाई में सहायक • उर्वरता बढ़ती है • (अत्यधिक पानी से हेडिंग, जड़ के क्षीण होने और लॉजिंग में विलंब हो सकता है)
पकी हुई फसल को काटना	मिल्क स्थिति में 1-2 सेमी	भरे हुए दाने मिलाएं (समय से पूर्व फसल निकालने से दाने अपरिपक्व हो सकते हैं और दाने टूट सकते हैं; देर से निकलने से भराव हो सकता है)

नींबू के जैसे पीली-हरी होती हैं, जो कि हरी होती हैं और कभी कभी सभी पत्तियां हल्की हरी और क्लोरोटिक के कोने पर ("V" आकार का पीलापन) हो जाती हैं । अगर नाइट्रोजन की मात्रा अधिक हो जाए तो पौधे कीड़ों और रोगों के लिए और अधिक आकर्षक हो जाते हैं और तने की ताकत कम हो जाती है ।

जिंक/जस्ता

चावल के पौधे में कई जैव रासायनिक प्रक्रियाओं के लिए आवश्यक प्रभावित फसल में असमान विकास और खराब स्थापना, कम जुताई और कम उपज दिखाई देती है । इस की कमी से पौधे की उपरी पत्तियां मटमैले भूरे धब्बे दिखाई देते हैं, पौधों के असमान रूप से बढ़ने और पर्वतीय खेतों के पौधों में धब्बे लेकिन फसल बिना उपचार के भी रिकवर हो सकती है, जुताई कम हो जाती है और Zn (जिंक) की गंभीर कमी होने पर फसल के पकने के समय में बढ़ोतरी हो जाती है और धान में स्पाइकलेट स्टरलिटी/बंजरपन बढ़ जाता है ।

फॉस्फोरस

यह टिलरिंग/जुताई, जल्दी फूल लगने, और पकने (विशेष रूप से कम तापमान वाले क्षेत्र में) को प्रोत्साहित करता है, यह बीज के निर्माण और दाने की गुणवत्ता को बढ़ाता है । इस की कमी से पत्तियां कोन के साथ-साथ किनारों पर अत्यधित हरी, लाल बैंगनी हो जाती हैं, पत्तियों के सिरे नष्ट हो सकते हैं, कमजोर पौधे और कम टिलरिंग पत्तियां, विशेष रूप से पुरानी पत्तियां संकरी होती है, छोटी, बहुत खड़ी, और अत्यधिक हरी होती हैं, पत्तियों की संख्या, पैनिकल, और प्रति पैनिकल दानों की संख्या भी कम हो जाती है ।

पोटैशियम

प्रति पैनिकल स्पाइकलेट बढ़ाता है, दाने पुष्ट होते हैं और दानों का वजन 1000 हो जाता है, लोजिंग, कीटों और रोगों के प्रतिरोधकता को बढ़ाता है । इस की कमी से पुरानी पत्तियों के कोनों पर पीलापन भूरापन पत्ती मार्जिन या गहरे भूरे रंग के धब्बे पोटेशियम की अत्यधिक कमी के कारण पत्तियों के कोनों में पीलापन और भूरापन, पत्तियों के किनारों के साथ-साथ ये लक्षण पहले पुरानी पत्तियों पर दिखाई देते हैं, पत्ती की आंतरिक शिराओं पर पीली धारियां नज़र आ सकती हैं और निचली पत्तियां नीचे को ओर झुक सकती हैं ।

फसल देखभाल और वृद्धि

खरपतवार प्रबंधन

खरपतवार पोषक तत्वों, पानी और सूर्य के प्रकाश के लिए प्रतिस्पर्धा करते हैं, उपज एवं गुणवत्ता को प्रभावित करता है, ये वैकल्पिक मेजबान के रूप में कीट और रोग की समस्या को तेज करते हैं और कटाई की क्षमता को कम करते है । इसके नियंत्रण के लिये नर्सरी में बुआई के 4-7 दिन पहले बूटाक्लोर (बंपर / मिल्क्लोर) @ 1-1.5 लीटर/एकड़ या एनिलोफोस (Army) @ 400-500 मिली/एकड़ का छिड़काव किया जाता है । और मुख्य खेत में रोपाई के 0-3 दिनों की भीतर प्रेटीलाक्लोर (रिफिट प्लस) @ 600 मिली/एकड़ का छिड़काव करना चाहिए या रोपाई के 2-3 दिनों की भीतर साथी @ 80 ग्राम/एकड़ का छिड़काव करना चाहिए या रोपाई के 15-20 दिनों की भीतर नोमिनी गोल्ड (Nominee gold) @ 80-120 ग्राम/एकड़ का छिड़काव करना चाहिए ।

रोग प्रबंधन

पर्ण झुलसा/ शीथ ब्लाइट

पत्तीओं के आधार तथा पत्तियों पर बड़े बड़े धारीदार हरे भूरे या पुआल के रंग के धब्बे बनते है पानी की सतह के पास काले भूरे रंग के धब्बे के रूप में दिखाई देते हैं जो कई सेंटीमीटर तक नीचे और उपर फैलते हैं और पूरे ताने को घेर लेते हैं बालियों के दाने भी बदरंग हो जाते हैं इस रोग की वजह से लगभग 50% का नुकसान हो जाता है । इसकी रोकथाम के लिये बीज का उपचार –– स्थूडोमोनारन फ्लोरेसेन्स की 1 ग्राम अथवा ट्राईकोडमा 4 ग्राम/ किलोग्राम बीज से करना चाहिए और खड़ी फसल में भेलिडा माईसिन कार्बेन्डाजिम 1 ग्राम या प्रोपिकोनाल 1 मी.ली/लीटर पानी में घोल कर छिडकाव करना चाहिए ।

झुलसा रोग/ ब्लास्ट

ये रोग धान के पत्ता, डंठल और बालियों मे आते हैं । पत्ता में आंख के आकार का निचे से उपर की ओर फैलता है जो बीच में राख और किनारे परिधि की ओर भूरा रंग में होता है, डंठल में गहरे भूरे रंग का धब्बा बनता है जो बाद में पूरा फैल जाता है जिस वजह से पौधा कमजोर हो कर मर जाता है और बालियां राख के जैसे और भूरे रंग में बदल जाता है । इसकी रोकथाम के लिये बीज का उपचार -- कार्बेन्डाजिम अथवा ट्राईसायक्लाजोल (बीम) 2 ग्राम प्रति किलोग्राम बीज से करना चाहिए या कार्बेन्डाजिम 12% + मैनकोज़ब 63% डब्ल्यूपी (साफ़) @ 300-400 ग्राम/एकड़ या बीम या कार्बेन्डाजिम 10 15 दिनों पर छिडकाव कर देना चाहिए ।

फाल्स स्मट/ आभासी कंड

रोगग्रस्त दानों के अन्दर कवक अंडाशय को एक बड़े कूट में बदल देता है, शुरुआत में पीले से लेकर संतरे के रंग का होता है, बाद में ये जैतूनी हरा रंग का हो जाता है, रोग दाने आकार में धान के दानों से दुगुने से भी बड़े हो जाते हैं और बाद में मखमली से दिखाई पड़ते हैं । इसकी रोकथाम के लिये बाली निकलने से पहले टिल्ट 1 मिली/लीटर अथवा कार्बेन्डाजिम 200 ग्राम अथवा ब्लाइटाक्स 50 (1 kg)को 200 लीटर पानी में घोलकर 15 दिन केअंतराल में छिडकाव करना है ।

जीवाणु पर्ण अंगमारी/ बैक्टीरियल लीफ ब्लाइट

पीले या पुआल के रंग के लहरदार धब्बे पत्तियों के एक या दोनों किनारों के सिरे से प्रारम्भ होकर नीचे की ओर बढ़ते हैं, ये धब्बे पत्तियों के किनारे के सामानांतर धारी के रूप में बढ़ते हैं, बाद में ये लम्बाई और चौड़ाई दोनों में बढ़ते है और पत्तियां सूख जाती है, रोगी पत्तों को काट कर एक ग्लास पानी में डालने से पानी दुधिया रंग में बदल जाता है । इसकी रोकथाम के लिये बीज का उपचार – स्थूडोमोनास फ्लोरेसेन्स 10 ग्राम/ किलोग्राम बीज से करन चाहिए और खड़ी फसल में एग्रिनाइसेन 100 का 30 ग्राम और कॉपर अक्सीक्लोराइड का 200 ग्राम/ 200 लीटर पानी में मिलाकर प्रति एकड़ की दर से छिडकाव कर देना है ।

भूरी चित्ती रोग/ब्राउन स्पौट

ये रोग बिचड़ा से लेकर दानें आने तक नुकसान पहुँचाता है पत्तियों में गोलाकार भूरे रंग के छोटे-बडे धब्बे बनते है, धब्बे के चारों ओर हल्की पीली आभा बनती है और पत्तियों पर ये पूरी तरह से फैले होते हैं, ये धब्बे आपस में मिलकर बड़े हो जाते है और पत्तियों को सूखा देते हैं, दानों के छिलकों पर भी भूरे से काले धब्बे बनते है जिससे चावल बदरंग हो जाता है । इसकी रोकथाम के लिये बीज का उपचार थिरम एवं कार्बेन्डाजिम (2.1) की 3 ग्राम दवा या

बेविस्टीन 2 ग्राम या कैप्टान 2.5 ग्राम दवा प्रति किलोग्राम बीज से करना चाहिए एवम रोग दिखाई देने पर मैनकोजैव के 2.5 मिली/लीटर घोल के 2 3 छिडकाव 10 12 दिनों के अंतराल पर करना चाहिए।

झारखण्ड राज्य में विभिन्न प्रकार के जमीन एवं परिस्थितियों के लिए धान की उपयुक्त किस्में

जमीन के प्रकार	अधिक उपजाऊ किस्में	उन्नत किस्में
ऊँची जमीन टॉड़-1 एवं 2	बाला, कावेरी, किरण, बिरसा धान-101 एवं कलिंग -111	ब्राउन गोड़ा 23-19 बिरसा धान-102, 105, 106, 107
मध्यम जमीन दोन-3	किरण, बाला, कावेरी, रासी पूसा-2-21, साकेत-4, पूसा-33, अन्नदा एवं बिरसा धान -201	सी.एच.-1037, सी.एच.-1039, सी.एच.-10
दोन-2	रतना, अर्चना, सीता, जया, आई.आर.36, सुजाता, बिरसा धान-202, राजेन्द्र धान-201, बिरसा धान--201, 202, आई.आर. 8 एवं राजश्री	बी.आर.-34, बासमती-370, राजेन्द्र धान-202
नीची जमीन दोन-1	कनक, बी.आर.-10, पन्त-4, महसूरी, पंकज, जगन्नाथ, राधा, जयश्री तथा पानी धान-2 बासमती-70, स्वर्ण (नाटी मंसूरी)	बी.आर.-8, बी.आर.-8, बी.आर.-9, बी.आर.-10, टी. 141-एवं सुगंधा

कीट प्रबंधन

पैडी स्टीम बोरर/ तना छेदक

शिशु कीट पौधों के तनों में छेद करके आंतरिक भाग को खाता है फलतः बीच की पत्ती सूख जाती है, सूखी हुई पत्तियों को खींचने से आसानी से खिंचा जाता है इसको " डेड हार्ट" या मृत केंद्र कहते हैं और बालियों की अवस्था में कीट का आक्रमण होने पर सम्पूर्ण बालियाँ ही सूख जाती है जिसको "वाइट इयर हेड" कहते है। इसकी रोकथाम के लिये बीज के अंकुरण के सात दिनों बाद कार्बोफ्यूरेन 3 जी @ 10 किलो/एकड़ का छिड़काव करें या अंकुरण के सातवें दिन के बाद से दस दिनों के अंतराल पर मोनोक्रोटोफास (Phoskill) @1.6 मिलीलीटर या क्लोरोपायरीफॉस (Tafaban) @ 2.5 मिलीलीटर/लीटर या क्यूनालफॉस(Ekalux) @2 मिलीलीटर/लीटर का छिड़काव करें।

लीफ फोल्डर/पत्ता मोड़क

यह पूरे खेत में पत्तियों के हरे उतकों को खा लेती है और उन्हें सफेद और सूखा बना देती है, कई संक्रमणों के दौरान पूरा खेत झुलसा हुआ दिखाई देता है। इसकी रोकथाम के लिये मोनोक्रोटोफास, 1.6 मिलीलीटर, क्लोरफायरिफस 2.5 मिलीलीटर या क्यूनलफॉस 2.5 मिली/लीटर का छिड़काव करें या कार्टेप हाइड्रोक्लोराइट 2 ग्राम/लीटर मिलाकर दस दिनों के अंतराल पर छिड़काव करें।

बकया कीट

ये कीट शुरू में पत्तों को आधा काटते है, फिर बाद में पत्तों का के हरे उतकों को खा लेती है और जिस कारण पत्तों का रंग सफेद हो जाता है । इसकी रोकथाम के लिये कार्टैप हाइड्रोक्लोराइड 4% जी 8 10 किलोग्राम/ एकड या क्लोरेंट्रानिलिप्रोएल 0.4% जी 4 4.5 किलोग्राम/ एकड डालना चाहिए ।

फसल की कटाई, सुखाई एवं भंडारण

बालियों के 80 प्रतिशत दानें जब पक जायें तब फसल की कटाई करें । कटाई के पश्चात् झड़ाई कर एवं दानों को अच्छी तरह सुखाकर भण्डारण करें।

उपज क्षमता

उपराऊ धान: 30 क्विटल, मध्यम व नीची जमीन (ऊँची किस्म): 40 क्विंटल; बौनी उन्नत किस्म: 60 क्विंटल तथा संकर धान: 80 क्विंटल प्रति हैक्टर ।

Man-animal conflict and coexistence

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The experience of human existence has always been linked to the existence of flora and fauna. The interactions between man and animal can be positive or negative, depending on the sharing of habitat, resources. Man has developed innovative adaptations to assume the superior ecological power on the planet. This dominance has led to the elimination of various species; altered dynamics of ecosystems; and indisputable loss of human life, crops, livestock, and property. The resolution of this conflict is crucial to the conservation and restoration of many species, and argues if the coexistence with other animals is guided by social, economical, and political friction within and among human communities.

Although the concerns of man-animal conflict exist from ages, it is only in the recent years we have begun to address the issue. This has now taken the form of an interdisciplinary subject and is emerging rapidly with an exponential increase in the number of publications on the subject. The number of research articles increased from 25 in 1995 to >1000 in 2020.

How to define the conflict and coexistence?

Man-animal conflict is generally defined as a dispute between humans and wildlife; human or animal acts may have an adverse impact on the other; Perils or risks posed by wild animals for human life, economic stability; or the belief that wildlife jeopardizes the human welfare. Wildlife means all non-domesticated plants and animals, but can also include domesticated and feral animals. Wildlife damage management is the art and science of ameliorating and mitigating the cynical effects of wildlife while sustaining or improving their beneficial aspects.

Conflict Coexistence

Significance of the conflict

Man-animal conflict has critical implications for biodiversity and ecosystem health, in addition to direct or indirect impact on the human welfare. Man can be injured or in more severe cases put to death (a) when the animals bite, claw, gore, or directly attack; (b) when animals bump into different means of transport employed by the humans; (c) due to transmission of a zoonotic disease or parasite. Animals can also substantially damage crops, livestock, and manly possessions and belongings. Indirect

damage due to conflict is rather difficult to assess, but can include potential losses to farmers, due to effects on livelihood and food security.

The interactions can be plotted on a continuous scale on both positive and negative axes, varying in intensity from minor to severe and in frequency from rare to common. Direct attacks by the predatory animals such as tigers, lions, and sharks are relatively less common, but when happen can be lethal and inviting strong public reactions. On the other hand, conflict between people and garden pests or birds such as geese may be more common, but incite less concern. The frequency and intensity of conflict can vary within and among the geographical locations. Extinction of a species may indicate the most extreme biological impact, while other species may be pushed to the brink of extinction or be considered endangered, due to declining numbers. Lowered abundance of large, predatory species may have cascading environmental repercussions for other species and ecosystem services and many of these are linked to conflict with man.

Historical and evolutionary aspects of the conflict

Evolution is primarily a story of interactions between the man and wildlife. Man's ability to thrive even in the face of adverse environmental scenarios has propelled him to adapt and carve a niche as a "superpredator". Predatory threats from wild animals were avoided by the early man probably because of surveillance methods, development of weapons. Modern vertebrate predators are those that have survived the environmental changes and competed with early man.

Expansion of early human populations and spread of agriculture led to substantial changes in the abundance of large vertebrates and extinction of large mammals, although new techniques and tools were aimed only to reduce wildlife damage.The governments initiated and implemented laws and policies to address wildlife conflict, with the aim of controlling bird damage in Scotland, eradication of wolves, foxes, and birds in new American colonies.

Such policies and support for control and eradication programmes in many areas continued in the twentieth century. Real and perceived conflicts led to eradication of wolves, extinction of three tiger species, whereas more resilient species such as coyotes and red foxes adapted better and survived.

General conflicts and location characteristics

Man–animal conflict and coexistence occur with endangered, plentiful pest, heavily managed or domesticated species in assorted ecosystems. Major focus has been on the species to be conserved, so as to protect the endangered species through resolution of conflict and fulfilling the needs of local communities. Overview of the types of man-animal conflict based on the taxa, location and impact can be presented as:

Giant terrestrial and amphibian animals: Size of animals is a strong indicator of conflict, as large predatory species and herbivores can cause injury to people and other livestock of lesser size. Giant animals that live on the ground or amphibians such as crocodiles that are adapted to ground, water and sometimes saline water habitats were the focus of many of the man-animal conflict studies.

Carnivores

Man has shown intense animosity towards big carnivorous species because of actual and imagined effects on human health and livelihoods. Felids and canids are especially at risk of confrontation with man due to their wide variety of habitats, animal size, and their dietary habits. The profuseness of these carnivorous species often depends on the availability of suitable 'prey'. Increased 'prey' density in the form of enhanced livestock availability tends to potentially higher rates of conflict. Three-fourths of the felid species across the globe are affected by man-animal conflict and the severity of such a conflict increases with the body mass of the animal. Man has injured, hunted, and eliminated a wide variety of animals. Severe drop in the number of wolves, jaguars, lions, wild dogs and tigers have been because of the man-animal conflict.

Herbivores and omnivores

Other animals including elephants, swine, and deer are also confronted by man. More than 60% of the largest terrestrial herbivores with a body mass of > 100 Kg are endangered, with severe impact on other animals and ecosystem.

These herbivores tend to trample, consume, and damage vegetation of ecological and socioeconomic value. More common is the conflict between man and ursids. Brown bears that use diverse habitats consume human-related foods, such as livestock, crops, and beehives. Wild boar causes agricultural damage. These conflicts are not confined to largest or dangerous animals; many smaller vertebrate species do compete with man for food as well as space.

Reptiles

Variety of reptiles, including snakes of different types come into conflict with man. Non-venomous reptiles such as alligators, crocodiles, and caimans can afflict serious and lethal injuries in humans.

Agricultural pests

While endangered animals such as tigers and wolves have gained significant recognition, other abundant animals also serve as sources of conflict in an economical perspective. Pests that affect agricultural crops, other animals or organisms that can be harmful to crops or livestock are the major source of agricultural damage.The common approach to pest control is to eliminate as many individual species as possible. Alternative approach is to disperse animals considered to be pests.

Ferals

Ferals such as wild and domesticated cats and dogs are regarded as predators. Cats and dogs can also cause conflict through predation on other wildlife, disease transmission, wildlife disturbance, hybridization, and direct attacks on livestock and people. Wild predators in turn kill domesticated pets. Wolves kill dogs, causing emotional and economic distress to dog owners. Other feral animals such as horses may be involved in trampling and grazing, impact on native habitats and species, and conflict with rural populations.

Marine animals

Oceans and water bodies also serve as sources for man-wildlife conflict. The marine conflicts could be direct attacks, bites, stings, and collisions, as well as impacts related to pollution, removal and modification of natural habitat, resource extraction, tourism and recreation, entanglement with fishing gear, and other harvesting activities.

Transmission of disease

Wildlife species act as sources of pathogens, and zoonotic and vector-borne diseases pose serious risk to livestock, human and wildlife health. More than 50% of all emerging infectious diseases are zoonotic, that can infect both humans and animals. Among these zoonotic diseases, 72% originate in wildlife.

Common zoonoses are bacterial diseases such as plague, brucellosis, tularaemia, anthrax, salmonellosis, and *Escherichia coli*; viral diseases such as rabies, West Nile virusinfluenza, and hantavirus; and transmissible spongiform encephalopathies (prion disease such as Creutzfeldt-Jakob disease, chronic wasting disease, mad cow, and scrapie.

Important diseases outbreaks of zoonotic origin in the recent past are Ebola, avian influenza virus A (H5N6) and A (H7N9), Middle East Respiratory syndrome corona virus, severe acute respiratory distress coronavirus 2, and cholera.

Conflicting factors

The probability of conflict between man and animal is to a great extent, determined by social and ecological factors at multiple scales. The root cause being the burgeoning human population and the subsequent rise in agriculture, land and resource utilization, technology, transportation, and energy. A variety of evolutionary, economic and behavioural causes also contribute to the cause of man-animal conflict. The conflict may not always be random, but conflict dynamics is difficult to assess due to the increasingly dynamic behaviour of species involved, their ecology, seasonal changes in cropping and husbandry activity, and availability of resources.

Population explosion and associated economic developments are radically modifying the planet. Urbanization is a major anthropogenic force and majority of the population is more urban than rural for the first time in the history of mankind. At the ground level, the underlying relationship between the human population growth and animal conflict is not clearly understood.

High human population densities may be associated with loss of carnivore abundance at local level in certain regions. Favourable laws and effective management practices appear to bemore relevant than the human population size or density alone. Small populations in rural areas tend to enhance conflict with carnivorous species as they adapt for landscapes with more prey and less human density.

Agricultural practices and intensity over the globe are likely to affect the natural ecosystem balance. The productivity of agriculture is likely to gain more importance and this can be achieved only if farmlands are increased by 200-300 million hectares by 2050. This will directly lead to a decrease in wildlife habitat. Livestock populations remain the major ecological as well as economic drivers on the Earth and the global increase in livestock numbers will be a determining factor in the man-animal conflict in some places. Degradation and loss of habitat due to increase in agricultural farming and retaliation for livestock predation are the major factors resulting in reduction of predatory animals.

Global population growth necessitated a massive expansion of transportation facilities, which led to increased chances of bumping with wildlife. Location and the frequency of transportation-related collision with various wildlife species like deer and moose are influenced by species-specific behaviours, traffic density and speed, and land cover and land use. Traffic on roads also causes bird deaths, while on the other hand bird strikes in aviation also have claimed human lives and had an economic impact on the aviation industry.

World energy requirements and consumption patterns are changing dramatically, the rising energy production, either from renewable or non-renewable sources, poses a great risk for both wildlife conflict as well as conservation strategies. Oil, natural gas, atomic energy exploration and exploitation, industrial solar installations directly impacts wildlife populations.

The chances of man-animal conflict are on the rise due to growing human populations, expanded agricultural farming, increased transportation network, and enhanced energy exploration; these means of conflict are to certain extent, in some countries, are targeted by stringent conservation policies. Increased wildlife habitat protection, although does little to reduce conflict, is known to result in better conservation outcomes.

Factors determining conflict and coexistence

Why some animals within populations are never or rarely involved in conflict, while others are occasionally involved and many others are habitually involved in the frequency of crop damage, livestock depredation etc. One of the key factors appears to be life stage of the animals that can determine the conflict frequency. When the animal is aged, injured or sick and the animal is forced into a suboptimal habitat by its younger competitors, it becomes incompetent to compete with other wild animals for prey; it is more likely to get into predating the livestock, damaging the crops, and other risky endeavours which increase the man-animal conflict. Animals in their young age are also likely to venture into risky behaviour in certain situations due to inexperience or group's social stratum and network, when the older animals have been targeted by hunting.

In addition to life stage, sex is another factor. Male elephants are known to be the cause of substantial crop raiding in Asia and African continents. Similarly, male felids are more aggressive in killing livestock and young male bears are seen to frequently venture into human habitats. Many of this conflict triggering species are known to be used to wider home ranges. On the other hand, females with cubs also resort to conflict.

Social learning evidently impacts the conflict behaviour, as the animals get to see the older close associates raiding the fields. The type, range and percentage of conflict is also governed by the availability of food, water and other ecological determinants. Availability of sufficient prey for the predators in the wilderness can significantly reduce the conflict probability.

Interactions of man with wildlife are to a great extent influenced by a broad variety of socio-cultural factors, including complex emotional perspectives, economics, governance and stakeholder involvement. Sometimes it does involve man-man conflicts and include variations in perceived threats to lifestyles, values and general views. Overestimation of perceived risk is considered a critical property that can influence wildlife conflict. Regardless of the size, rodent or invertebrate may cause more extensive damage than visibly large, potentially dangerous vertebrate species. The media plays an important role in framing the conflict and can influence the public opinion. Proper educational measures can encourage non-conflicting behaviors. With enforcement the man maybe moved away from the protected areas.

However the success of educational programs as well as enforcements requires attitudinal commitments from the population. The communities have to engage in groups to reduce conflict, but non-cooperation and distrust disengage people from meaningful ways to avoid conflict. Incongruence in assessing the scale of the problem, stringency with which the legislation and law enforcement work also play an important role. Educational status directly impacts the mitigation measures. Gender specific interaction with the environment and the way they deal with conflicts may predispose the communities to these conflicts. The historical context is also equally important. Many communities have coexisted with carnivorous species for years, and have established livestock husbandry techniques including shepherding and night corrals along with development of policies such as stable land tenure, and strong legal protection.

In villages, poor management of livestock often leads to inadvertent livestock predation. Seasonal husbandry such as lambing and calving which may involve livestock migration into vulnerable habitats posed serious risk, while constant monitoring by the humans can reduce the risk. In the urban areas both lethal and nonlethal conflict situations involve damage to landscapes, gardens, destruction of public spaces, noise pollution, picking up garbage bins. The urban environment may act as a notorious ground for wildlife killing, including road accidents, collision with bungalows, depredation, and disease.

The animals that get displaced into the human landscapes show behavioral differences potentially increasing the opportunities for conflict.

Managing the wildlife conflict

Both lethal and nonlethal approaches are emerging to prevent or to reduce the frequency and severity of conflict. Activities that are regulated or unregulated, methods employing expensive infrastructure and contribution from the government could be involved. Low-cost tools with individual's commitment also serve to reduce the conflict.

Lethalis rather a controversial method to fix the damage done by the animals. This may involve eradication of the entire

population of a particular species in the extreme conditions. Awarding bounties to reduce and eliminate the predator populations has often been cited in history. However lethal control is more commonly employed to limit the more abundant species such as coyotes and selectively removing more aggressive animals that have been directly threatening the human life. Lethal control measures include use of firearms, poison, traps such as snares and rotating jaw traps.

Regulated harvest of animals combines monitoring of the numbers followed by lethal control to achieve management objectives. Sanctioned lethal control such as sport hunting is commonly used as a preventive or remedial measure. Unregulated or illegal harvesting is a serious conservation concern for various species. Hunting of animals may lead to increased infanticide, hybridization, perturbed social structure, reduced juvenile survival and recruitment. It can also lead to attenuated gene transfer among populations. In certain contexts, targeting of chosen species may severely reduce the conflict.

Various nonlethal strategies are preferred to reduce conflict, while considering the conservation concerns. This may involve moving the wildlife away from people and livestock, using guard animals, mechanical tools and chemicals to deter wildlife. Translocation of animals from high to low conflict areas has been typically low. The problem with translocation is the depth of the target animals during transport construction of barriers and use of exclusionary devices aims to limit the wildlife damage. The barriers restrict the wildlife movement, inhibit disease transmission, and protect highly endangered species. Use of natural barriers is more preferable in order to avoid unwanted damage to the animals. Traditional barriers such as 'bomas' in parts of Africa or hybrid living walls serve the purpose.

Modification of habitats to discourage the animals may require draining of the ponds and removing certain vegetation. Providing alternative sources to divert the attention away from valuable crops is also a viable alternative.

People watching over the livestock or crops can avoid damage and reduce conflict and this has been practiced for over years. This old, but successful strategy involves labor costs and constant vigilance. Not all predators can be deterred by people, especially at nights. Modification of livestock husbandry practices that include changing of planting and harvesting schedules, which are very much dependent on climate and weather conditions, modification of grain storage facilities and barns so as to protect them with barriers can reduce the conflict frequency and severity. Leaving the livestock in an enclosure rather than allowing them to roam free at nights will likely reduce the chances of conflict. Training of guard animals, such as dogs and Llamas can protect livestock from cheetah, coyotes, cougars, wolves and black bears. Wild carnivores can sometimes even kill these trained guard animals due to their inattentiveness and such killing can involve retaliation and resentment furthering the chances of conflict.

Technologies commonly in use to capture or deter unwanted wildlife include restraining traps, snares, nets, and cages. Fear-inciting visual, auditory, olfactory triggers, chemicals, or tools that startle or divert animals can be used for repelling

animals. Fire crackers, torches, or bang pans are used for deterring elephants. Wildlife can be discouraged from repeatedly raiding crops or attacking livestock with the use of aversive conditioning, application of negative stimuli to modify behavior such as bad tasting chemicals or herbals that induce vomiting, electric shock collars, rubber bullets, loud noise or lights and plants that smell bad.

Radiotelemetry is a newly emerging technology that can be widely used for understanding and reducing man-animal conflict. Sending out signals when the livestock are sedentary for longer periods will enable the managers to quickly assess the cause of death or to determine whether predator movements are associated with temporal variation in depredation behavior. Medical approaches such as sterilization programs, fertility control through mechanical and surgical methods, endocrine disruption, and immunocontraception can also be used to reduce conflict.

The role of humans in managing the conflict

Man either tries to manage the wildlife or build barriers to reduce the damage caused by the wildlife, but deep introspection and attitudinal/behavioral change from the human side could bring in better changes towards managing the conflict. The common tools used for investigating the human dimensions of conflict and coexistence are surveys, interviews, direct field observations, ethnographic approaches, community participation and focus groups and other forms of direct engagement with communities and stakeholder groups.

Public policy is one important tool that can promote the coexistence of man and wildlife. Most notable among these include stable political institutions, national/international laws, effective law enforcement, wildlife friendly economic and agricultural policies.

Strategies that can promote people working together to resolve the conflicts in a coherent fashion include education, information sharing, co-management, collaborative and participatory planning, risk assessment, strategies to change perceptions, poverty alleviation programs, community-based natural resource management and other forms of stakeholder engagement and processes. Spatial zoning works as a land use conservation tool, to delineate wildlife areas and people areas. Such zoning can regulate management objectives, restrict access, control responses, andhelp to prioritize economic outlays, such as subsidies or compensation.

Economic incentives are expected to increase the tolerance for predators and other wildlife. These economic tools could be in the form of compensation, insurance, performance payments and incentives. Compensation involves reimbursing with cash or in-kind payments to people who have suffered damage to crops or livestock, or personal injury or threats from wildlife.

Drawbacks associated with compensation schemes are difficulty in tracing the cause of damage, slow, cumbersome, or insufficient payment, high transaction costs and problems of trust and transparency. These compensation programs aim at direct effects of livestock losses, but do not address indirect losses such as insufficient weight gain in livestock from stress, that can also affect animal health and reproduction. Assessment of the damage and pricing is a

difficult task. The farmers may have little incentive to protect livestock if they can obtain economic compensation for depredation, which becomes a moral hazard. This is addressed with requirement of proof of improved livestock husbandry to receive such payments. These are performance payments that compensate people on the condition of wildlife abundance.

Such payments ensure a direct link between monetary payments and the production of desired conservation objectives. The traditional subsidies are not typically linked to conservation outcomes.

Insurance schemes are akin to compensation programs but do required participants to pay a premium. The insurance schemes can promote fair payments by better incorporating the risk into the price of premium and payments. Sometimes these schemes are also challenged by the risk of fraudulent claims and adverse selection. Challenge of small pools of participants and high premiums could be addressed with supplemental funds from various government or nongovernment support, community financing or better risk evaluation.

Other economic incentives and benefits may offset the cost of conflict. Photographic tourism and other forms of ecotourism in which tourists pay local communities to see wildlife may reduce incentives to eliminate wildlife that cause conflict.

Conclusion

Advances have been made in understanding the importance of man-animal conflict, biological and social factors that influence conflict, and strategies to reduce conflict and promote coexistence, but this interdisciplinary field is still in its infancy and a spectrum of opportunities exist for further improving the situations.

Nature talks about man-made forests: (Miyawaki method)

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Although the word forest is commonly used, there is no universally recognized precise definition, with more than 800 definitions of forest used around the world. The word *forest* derives from the Old French *forest* (also *fore's*), denoting "forest, meaning vast expanse covered by trees. It is

also defined as a plant community predominantly consisting of trees and other woody vegetation, usually with a closed canopy. But legally, it is defined as an area proclaimed to be forest under forest law. In Indian context during the period of British invasion, the systematic approach of forest management has started to sustain the ecological balance and stability of the forest. In the recent past, innovative reforestation approaches have gained decisive attraction towards increasing the forest cover and climate amelioration. It composes many plant species which may be of principal, accessory or auxiliary species out of which, principal type of plant species is the one which are most important in a mixed forest either by volume or value. Forests classification is defined as the grouping and arrangement of forests based on defined criteria such as composition, age, climatic elements, structure, habitat, etc., Out of which, we are going to discuss about natural regeneration (forests) and artificial regeneration (forests) type of forests. Regeneration is the renewal of forest crops. Natural regeneration is nothing but native forest created on its own by nature by self-sown seeds or coppices or by root suckers. Seed dispersal may be done through wind, water, gravity, birds and finally by animals. Where the germination capacity and germination energy at that specific time, year etc. matters for regeneration. And coming to the artificial regeneration, it is defined as renewal of forest crop by sowing, planting or other artificial means and it can be done either by afforestation and reforestation works. Here many factors influence the reforestation process like yield,

risk of damage by pests, genetic considerations, Time and cost etc., The accomplishment rate of any man-made forest depends on various sequences of events, like site selection, ground clearance, soil nutrient enrichment, species selection, pits dimension, planting pattern, usage of organic bio fertilizer and post planting management.

Choice of species

The species selected according to humans needs, should be able to adapt the climatic conditions according to area selected, they should also be able to improve soil fertility and reduce soil erosion, should withstand pests and disease factors and at last should be fast growing. One of the methods to increase forest cover now-a-days is using Miyawaki method**.** According to a study of World Resource Institute, in India, nearly 1.6-million-hectare forest area was wiped out between 2001- 2018. This significantly contributed to the immediate shifts in the global climatic conditions, mainly led by global warming. Concerning this aftermath, the Indian Government professed to turn 33% of its geographical area into green forest cover by 2022. Hence, the Miyawaki Forest Method in India can be employed to facilitate the process of establishing the tree cover to help reach this objective, which currently stands, covering 24% of the forest area.

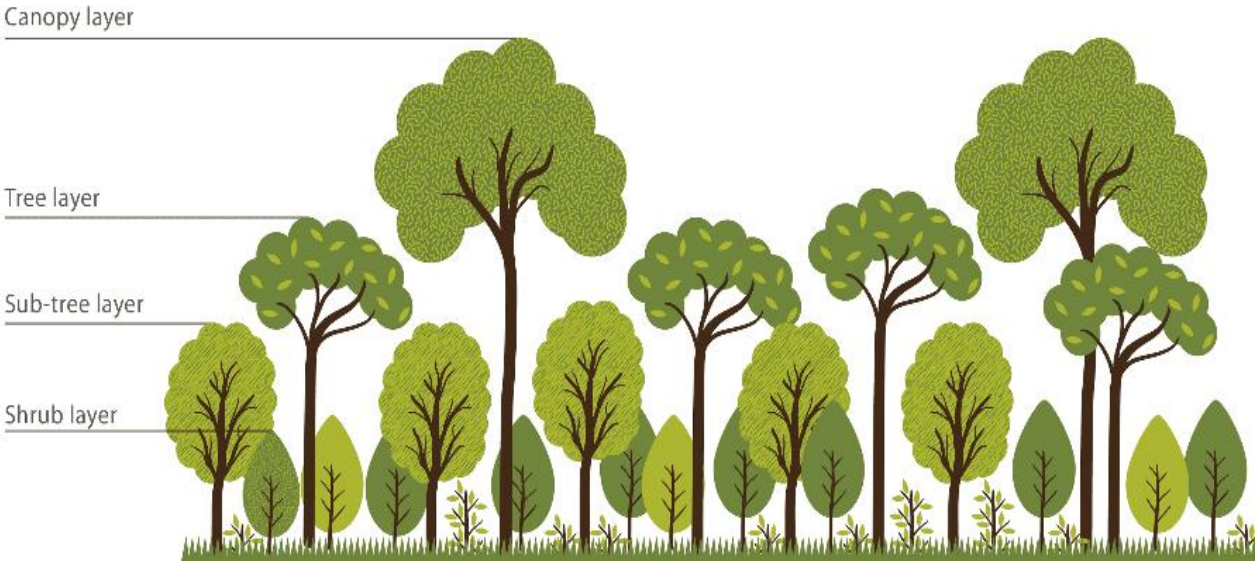
Introduction to Miyawaki method

A Hall of fame Professor "Akira Miyawaki" is a Japanese botanist, well known plant ecologist and expert in restoration of natural vegetation on degraded lands. He invented the "Miyawaki restoration technique" to protect the lowland areas against natural calamities of tsunamis. The basic principle of Miyawaki is high density plantation in small pieces of land with native tree species; it can certainly protect the low-lying areas from natural disaster. Among the different types of greenery, real forests made up of trees native to the area are three-dimensional, multi-layered communities having 30 times the surface area of greenery of single-layered lawns, and have more than 30 times the ability to protect against natural disasters and to conserve the environment. These forests are completely unyielding to natural disasters such as fires, earthquakes, typhoons, or tsunamis. So, the greenery that is most important to us now is the greenery of native forests made up of trees native to the area, as symbolized by the groves of village shrines. Native forests protect life and protect the environment. In India, Shubhendu Sharma, an industrial engineer, introduced the Miyawaki technique in 2011.He first observed this technique while assisting botanist, Akira Miyawaki during the cultivation of a forest at the Toyota plant where he worked. Later on, he made his first attempt with this method in his backyard which obtained positive results. After much planning and analysis of the entire methodology, he finally took the initiative with Afforest to render services in building thick, native forests. In Telangana, this drive was taken up by Dr. G. Chandrasekhar Reddy (IFS, Addl.PCCF) of Telangana state. He established this method in Yadadri and Choutuppal divisions of Telangana state under the project Telanganaku Haritha Haram (TKKH) in 2018, TKHH is a large-scale tree-planting program implemented by the Government of

Telangana. The plan aimed to increase the amount of tree cover in the state from 24% to 33%, The flagship programmes aims to rejuvenate degraded forests, protecting these forests from threats such as smuggling, encroachment, fire and grazing. Using this method, His case studied the entire area of these divisions and established this Miyawaki model at different areas of these two divisions, out of which 1 site which was established in 2018 gave a very good result in building dense forests and rest are in progress.

Methodology involved

It has been proven that restoration of native forest is possible by collecting seeds and seedlings of climax species in the forest, raising them in a nursery and after adaptation planting the young plants on sites adequately prepared. Basically, the plantation is done as four different layers:



Emergent (canopy) layer, Tree layer, Sub-Tree layer and finally, shrub layer.

So that, plantation growth rate will be high as they get equal amounts of light, etc., For 1 acre of land, 4000 species are used. Miyawaki follows 4 basic principles for this forest regeneration like using indigenous species, proper land preparation, species mixing and competition (following 3 seedlings pre sq.mt), and lastly, water conservation habitat to plants by making proper land preparation for better water retention but in India, many ecologists suggested and follow6 steps in commitment to Miyawaki method.

Step.1

Soil survey

This step includes surveying of proposed site area to obtain critical information pertaining tothe parameters like soil texture, organic carbon content, soil pH which to get an overall assessment of soil properties like

Step.2

Surveying native indigenous species & biomass

Native species survey will entail visiting the local site and surrounding areas, conducting PNV's indifferent seasons, generating primary and secondary data and gathering information of all the species for quantitative and qualitative indices.

Step.3

Sapling procurement

The species to be planted were selected from a phytosociological study of comparable sites still covered by natural vegetation. If whether the seeds are collected from natural tropical forests and prepare own saplings, they should be transplanted when they reach 2- 3 leaf stage to pots and should be screened and make them adapt to environments and soils. And if want to make a procurement from local nursery, the sapling procurement and the choice of species selected should be healthy and risk-free form any infestations and also checking propagation methods of particular species and ensuring that they are as per Miyawaki method standards. Saplings should be selected according to area and climate of particular site, native plants.

Step.4

Soil preparation

All the area of the site should be cleared relieving the native plants present in that area which are need for our forest creation. Soil digging at a depth of 30 cms and kept aside on all four sides. Then the dug up are is ploughed up to 10 cms and collected dried leaves, grass and green manure are spread @ 8 CMT per acre. Urea is also applied @10 kg per acre for accelerating the decomposition rate. After that, 9 cms of soil layer is covered and FYM is applied @ 200 Cft peer care and then covered with 9 cms of soil and then watered. Then vermicomposting is added @ 80 Cft per acre and Earthworms are also added @ 1kg per hectare and lastly, covered with soil as top layer and watered for 3 weeks. Criss cross ploughing is done and 30 cubic cm pits are dug for plantation purpose. And the left-over soil is turned to make a small bund forming on all sides of the site area. Some ecologists also use coconut shells, sugarcane bagasse at the bottom of soil preparation.

Step.5

Plantation

2-3, pot seedlings are to be planted per square meter area to obtain densely mixed forest environment.

As discussed above, plantation method in Miyawaki does not follow any definite spacing patterns, but the planting is done according to different canopy layers and as discussed and make sure before planting, root zones are secured and planted with microbial enhancers etc., after planting, grass layer is covered between saplings for better water retention and also to control weeds development. In one-acre area, 4000 plants of different species of plants are used which multiplies to 10,000 plants for a hectare area. Almost 30 trees are planted in 10 sq. mt. area. Community Plantation helps the people about the methodology involved in and also makes them aware of the need for forests for living a sustainable life.

Step.6

Maintenance monitoring of sited area

Miyawaki forests requires maintenance for first 2-3 years in the form of proper irrigation (weekly 2-3 times), pest monitoring. Pest management practices are done if only they reach the threshold level otherwise, pest management is avoided.

Results

Miyawaki methodology gave very good outputs in tropical and subtropical areas. The possibility of breeding grounds is also high. The climate of sited areas viz., Yadadri division and Choutuppal division shows Moderate climate in all seasons with

beautiful hillocks. Maximum growth of different species increased during June to December. As the plantation is done in 2018, all the species attained 6-7 mts height. Dendrocalamus species are also used along the edges of the site area which are showing a good growth. Actually, grass species are not used in Miyawaki method, but running them along the edges may be useful in future for livelihoods which do not affect the adjacent species and forest can be covered easily without damaging the adjacent species. The area we have gone through for studying is mostly covered by the tree species, but with good growth of trees with good height and diameter, with the minimal attack of pests and disease. During the study in Telangana, we mostly came across the many tree species, and the area is densely covered with vegetation fully with the abundant trees and grass species and which is mimicking the real natural forest. This method increases the SPM level, ground water recharge, and increase in biodiversity, dense growth of plantations, more co_2 absorption, and also habitats for pollinators

Conclusion

YNFM is providing various benefits to the people. The growth of the plantations were really good with morethan 80% survival. The insects and pest attack was really less. It was acting really like a natural forest by provinding different benefits like tree cover, timber , fruits, reduces soil erosion, reduces the temperature means green house gases, act as migratory routes and breeding grounds for different animals.Its better to make dense culture i.e., multi layered forests rather than turning lands as gardens, conventional plantings (Monoculture) which increses the sustainabillity in the former.We from FCRI, Hyderabad, are also going to establish a model in our campus area within a short time as we got proper idea about methodology of estabishment, we already done with the PNV's of the areas, and ready for land prepartaion and sapling procurement and futher steps. We would also check the Mycorrhizal associations and in the soil and as we discussed, Miyawaki mthod also best suits for urban forest cover and for site seeings; to increase the possibility of breeding grounds, we are under research to use only organic pesticides which are prepared from bio excretes and also under research to add a plant species of non-native species in urban areasand making that habit to grow in local envoironments which helps in breeding grounds for migratory birds which best suits for urban forest creation models and also it whould act as tourist spot to capture different life forms, Bird watch etc for visitors as mapping of plantation is also done securely in acreative way with the cordial help of our Addl. PCCF Dr. Chandrasekhar Reddy sir andalso with our project priclipal investigators, Mr. Jagadeesh. B, Dr. Sreedhar. BFCRI

Methodology of Establishment

Digging of soil

- Dig the soil up to 30cm .
- Tillage should be with the help of Cultivator.

Biomass application

- Grass (1 cm layering), dried leaves, Gliricidia and Lawn grass are used.

Farm Yard Manure(@200 Cft/acre), Urea application(@120kg/ acre).

- Wetting land after 9cms of soil cover

Wetting of land for 2-3 weeks

Vermicompost application(80 Cft/ acre, Earthworms @ 1kg / ha)

Plantation with local comunities,

Water conservation, Mulching , Weeding (1st year)& Management work

At last, we would like to show sincere gratitude for some great scientists, Ecologists etc., who's striving for conservation of nature with an aim of sustainable life development and also our solmn thanks for their teachings., we would be nothing without their efforts

जैविक-जलनिकास (बायोड्रेनेज): जल संरक्षण हेतु सर्वश्रेष्ठ विकल्प

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प्रस्तावना

समगतिशील (टिकाऊ) खेती में पौधों की उचित वृद्धि हेतु जड़ स्तर में जल, वायु एवं लवण उचित संतुलन में होना चाहिए । यह संतुलन पर्याप्त जलनिकास द्वारा ही सम्भव हो पाता है । भूमि पर पाये जाने वाले समस्त प्रजातियों का जीवन जिस प्रकार जल की कमी से नष्ट हो जाता है । वैसे ही व्यर्थ जल भी उनकी वृद्धि व जीवन को नष्ट कर देता है । फसल की पैदावार बढ़ाने हेतु भूमि की सतह अथवा अधोसतह से अतिरिक्त जल को बाहर निकालना ही जलनिकास कहलाता है । जलनिकास प्राकृतिक अथवा कृत्रिम दो प्रकार का होता है। अधिकांश भूमि में सतह एवं अधोसतह से प्राकृतिक रूप से जल निकास होता रहता है । किन्हीं कारणवश प्राकृतिक जलनिकास में बाधा उत्पन्न होने पर जलनिकास क्षमता को बढ़ाने हेतु कृत्रिम जलनिकास की आश्वयकता पड़ती है । सिंचित कृषि को बनाये रखने हेतु कृत्रिम जलनिकास अतिआवश्यक है। सिंचित पद्धतियों में बढ़ते भू-जल स्तर को बनाये रखने जलभराव एवं लवणता को नियंत्रित करने के लिये अधोसतह जलनिकास का होना आवश्यक है । पारम्परिक अधोसतह जलनिकास प्रणाली दो प्रकार की क्रमशः लम्ब अथवा उर्ध्वाधर (नलकूप) एवं क्षैतिज (निकास नालियाँ) होती है । इन पद्धतियों को उचित रूप से अभिकल्पित, स्थापित एवं देख-रेख करने से ये न केवल भू-जल स्तर को कम करते है अपितु सिंचित भूमि में लवणता की सम्भावना को भी नगण्य रखते है । किन्तु इनमें दो खामियाँ भी होती है। ये मंहगे होते है तथा इनके द्वारा जलनिकास बहिस्त्राव उत्पन्न होता है जिसे वहां से सुरक्षित बाहर निकालना आवश्यक हो जाता है ।

उपरोक्त जलनिकास पद्धतियों में उत्पन्न होने वाली त्रुटियों के समाधान का सर्वश्रेष्ठ विकल्प जैविक-जलनिकास (बायोड्रेनेज) है । जो न केवल सस्ती बल्कि पर्यावरणीय हितैषी भी होती है । इस पद्धति में जलनिकास-सह-जल निष्पादन दोनों गुण सम्मिलित होते है। जैविक-जल निकास पद्धति में यांत्रिकी साधनों की अपेक्षा अतिरिक्त जल को हटाने के लिये वनस्पतियों का उपयोग किया जाता है । जैविक-जलनिकास परिकल्पना का मुख्य आधार पौधों द्वारा अतिरिक्त जल का उपयोग करना है । ये पद्धति आर्थिक रूप से आकर्षक होती है क्योंकि इसमें प्रारम्भ में सिर्फ वनस्पतियों के रोपण में खर्च आता है । जब ये स्थापित हो जाते है तो यह पद्धति आर्थिक रूप से लाभ देने लगती है, जिसके अंतर्गत चारा, काष्ठ,

रेशा एवें अन्य वन उत्पादों की प्राप्ति मुख्य है । इसमें एक मतैक्य यह भी है कि यदि जैविक-जलनिकास पद्धति को उपयुक्त रूप से कार्यान्वित किया जाता है तो यह भू-जल स्तर को कम कर देती है । जबकि यह पद्धति उन स्थानों पर जहां हमेशा जल-भराव तथा नहरों से जल रिसाव की स्थिति होती है को स्थायी रूप से दूर कर देता है।

परिभाषा

जल-भराव क्षेत्रों में भूमि की सतह अथवा अधोसतह से अतिरिक्त जल को जैविक रूप (वनस्पतियों) से बाहर निकालना ही जैविक-जलनिकास (जैविक जल प्रबंधन) कहलाता है ।

जैविक-जलनिकास के उद्देश्य

जैविक-जलनिकास का मुख्य उद्देश्य अतिरिक्त भू-जल स्तर को वनस्पतियों के वाष्पोत्सर्जन प्रक्रिया द्वारा कम करना है । इसके लिये भू-दृश्य क्षेत्र की वाष्पोत्सर्जन क्षमता बढ़ाने के लिये अधिक जल का उपभोग करने वाली वनस्पतियों का रोपण जल भराव/निकास प्रक्रिया में संतुलन बनाये रखने के लिये किया जाता है। इससे कृषि फसलों में जड़ स्तर के नीचे भू-जल स्तर हमेशा संतुलन में रहता है।

जैविक-जलनिकास द्वारा पूरी की जाने वाली आवश्यकतायें

किसी स्थान पर उचित रूप से जैविक-जलनिकास प्रक्रिया अपनाने से उस स्थल की निम्नलिखित आवश्यकतायें पूर्ण होती है-

- **जल संतुलन** : भू-जल स्तर में हमेशा संतुलन बना रहता है।
- **लवण संतुलन** : भूमि में लवणों के स्तर में भी संतुलन बना रहता है।
- **वृक्षारोपण के अंतर्गत आने वाले क्षेत्र** : पर्यावरण एवं जलनिकास की दृष्टि से जल भराव क्षेत्रों में वृक्षारोपण करने से भूमि का समुचित उपयोग होने से वनों के क्षेत्र को बढ़ाने में सहायता प्राप्त होती है।
- **वृक्षारोपण हेतु आवश्यक जल** : जलभराव क्षेत्रों में वृक्षारोपण करने से वृक्ष प्रजातियाँ अतिरिक्त जल का उपयोग कर बढ़वार करते है। अतः इन स्थानों में पौध प्रजातियों के विकास हेतु सतही सिंचाई की आवश्यकता नहीं पड़ती।
- **भू-जल स्तर गुणवत्ता** : इस स्थानों पर जल की गुणवत्ता हमेशा अच्छी बनी रहती है।
- **भू-जल स्तर पर प्रभाव** : जलभराव वाले स्थानों पर वनस्पतियां भू-जल स्तर को कम करने में सहायक होती है।

जैविक-जलनिकास पद्धति का वैज्ञानिक आधार

प्रकृति में जलीय चक्र के प्रमुख घटक जैसे वर्षा, वाष्पीकरण, उत्स्वेदन, जल-मृदा भराव एवं जलनिकास में परिवर्तन सभी संतुलन में होते है । अधिक वर्षा होने से अस्थायी रूप से जलनिकास बहाव में बढ़ोतरी होती है जिससे भू-जल स्तर एवं मृदा आर्द्रता संग्रहण क्षमता बढ़ जाती है । 5 से 10 वर्षो पश्चात् इनमें संतुलन स्थापित हो

जाता है। वनस्पतियां वाष्पोत्सर्जन एवं मृदा जल संग्रहण क्षमता बढ़ाने में मुख्य भूमिका निभाती है। जैविक-जलनिकास पद्धति अपनाने के रिसाव, पौधों द्वारा जल के उपयोग, लवण संतुलन तथा भू-जल स्तर में आपस में संतुलन बना रहता है।

जैविक-जलनिकास पद्धति के विकास में ध्यान देने योग्य बातें

किसी भी स्थान में जैविक-जलनिकास पद्धाति का विकास करते समय निम्नलिखित बातों पर ध्यान देना अत्यन्त आवश्यक है -

जल संतुलन

जैविक-जलनिकास पद्धति में वृक्षारोपण कुल भराव क्षेत्र के अनुपात में भू-जल आयतन के बराबर जल का उपयोग करने में सक्षम होते है। अतः इस परिस्थिति में जल संतुलन इस प्रकार बनाये रखना चाहिये कि भू-जल जड़ स्तर के नीचे ही बना रहे।

वृक्षारोपण क्षेत्र

जैविक-जलनिकास पद्धति में वृक्षारोपण क्षेत्र जितना कम हो उतना ही उपयुक्त है। कृषि (विशेषकर सिंचित कृषि) मुख्य रूप से अधिक आयतन देने वाली फसल प्राप्त करने के लिये किया जाता है। शुष्क तथा अर्द्ध-शुष्क क्षेत्रों में वे स्थान जो कि सिंचित क्षेत्र के अंतर्गत आते है वहां पर कोई अन्य उत्पादक संसाधन की अपेक्षा वृक्षारोपण का चुनाव करना चाहिये।

भू-जल स्तर को बनाये रखने में

फसल जिनमें वृक्ष भी आते है, जैविक पम्प (बायो पम्प) के रूप में कार्य करते हुये वृक्षारोपण क्षेत्र के नीचे आने वाले भू-जल स्तर को कम कर देते है। जिसके परिणामस्वरूप आस-पास के क्षेत्र का भी भू-जल स्तर कम हो जाता है। वृक्ष/फसल द्वारा कितने जल का उपयोग किया गया यह वृक्ष/फसल की जल उपयोग क्षमता, जल भराव दर, भू-सतह एवं मृदा गहराई पर निर्भर करता है। अतः इस पद्धति में वृक्षारोपण पट्टियों या खण्ड़ों में किया जाना चाहिये। वृक्षों की कटाई अथवा विरलन के समय इस बात का भी ध्यान रखना चाहिये की जल निकास क्षमता पर उसका विपरित प्रभाव न पड़ें।

आर्थिक पहलू

जैविक-जलनिकास पद्धति के अंतर्गत वृक्षों तथा फसलों में विभिन्न प्रकार की सस्य क्रियायें की जाती है। वृक्षारोपण कार्य तथा प्रत्येक वर्ष किये जाने वाली देखभाल में ये सभी खर्च भी शामिल होता है। अतः इस प्रकार के वृक्षारोपण में इन बातों का ध्यान रखना अत्यंत आवश्यक हैं कि वह भू-स्वामियों द्वारा स्वीकार्य हो एवं आर्थिक रूप से भी लाभकारी हो।

सामाजिक स्वीकार्यता

किसी भी स्थान में नई फसल जैसे वृक्ष प्रजातियों का वृक्षारोपण ग्रामीण सामाजिक समुदाय को प्रभावित करता है। उस स्थान में उत्पाद के विक्रय हेतु बाजार की तलाश, सुरक्षा एवं अन्य पहलुओं का भी ध्यान रखा जाता है। अतः किसी भी स्थान में जैविक-जलनिकास पद्धति के अंतर्गत किये जाने वाले वृक्षारोपण में ग्रामीणों की सक्रिय भागीदारी होना अत्यंत आवश्यक है। जिससे

भविष्य में आने वाली समस्याओं को दूर करने तथा उससे प्राप्त होने वाले लाभों को वृहत स्तर तक पहुंचाने में सहायता प्राप्त होती है।

जैविक-जलनिकास पद्धति हेतु वृक्ष प्रजातियों का चुनाव

कोई भी वृक्ष/पौध प्रजाति जो कि जलमग्न क्षेत्र में उगने का गुण रखते है, जैविक-जलनिकास पद्धति हेतु उपयुक्त होते है । किन्तु वे प्रजातियां जो निम्नलिखित वांछित गुण रखती है जैविक-जलनिकास पद्धति हेतु उपयुक्त होती है:

1. प्रजाति जलमग्नता जैसी स्थिति को सहन करने वाली होना चाहिये।
2. प्रजाति की वाष्पोत्सर्जन क्षमता अधिक होना चाहिये।
3. प्रजाति ज्यादा जल उपयोग क्षमता रखने वाली होना चाहिये।
4. प्रजाति बहुवर्षीय होना चाहिये।
5. प्रजाति जहरीले पदार्थ स्त्रावित करने वाली नहीं होना चाहिये।
6. प्रजाति लवणीय एवं क्षारीय दशाओं को सहन करने वाली होना चाहिये।
7. प्रजाति सदाहरित गुण रखने वाली होना चाहिये।
8. प्रजाति चौड़ी पत्ती वाली होना चाहिये।

उपयुक्त प्रजातियाँ

बहुत सारी वृक्ष प्रजातियाँ जैविक-जलनिकास का गुण रखती है, किन्तु निम्नलिखित वृक्ष प्रजातियाँ जैविक-जलनिकास हेतु उपयुक्त पाई गई है:

- *यूकेलिप्टस कैमालडुलेनिसस* (नीलगिरी)
- *यूकेलिप्टस सिट्रिओडोरा* (लेमन सेंटेड नीलगिरी)
- *यूकेलिप्टस टेरोटिकौर्निस* (सफेदा)
- *टर्मिनेलिया अर्जुना* (अर्जुन)
- *अकेशिया नीलोटिका* (देशी बबूल)
- *एन्थोसिफेलस कदम्बा* (कदम्ब)
- *पोन्गैमिया पिन्नैटा* (कंरज)
- *बैम्बूसा बम्बोस* (कांटा बांस)
- *प्रोसेपिस जूलिफ्लोरा* (विलायती कीकर)

निष्कर्ष

जल भराव क्षेत्रों को सुधारने हेतु जैविक-जलनिकास पद्धति सबसे उपयुक्त है। यह प्रणाली कम लागत, अतिरिक्त आय एवं पर्यावरणीय हितैषी होने के कारण अत्यंत लाभदायक है । जलमग्न भूमियों में अगर जलनिकास का उचित प्रबंध न हो तो कार्बन-डाइऑक्साइड की मात्रा बढ़ जाती है, और यह कार्बन-डाइऑक्साइड पानी के साथ मिलकर कार्बनिक अम्ल बनाती रहती है । फलस्वरूप मृदा अम्लीय हो सकती है। अम्लीय भूमियों में एल्युमिनियम व लोहे के लवणों की मात्रा आ जाती है जो फसल की बढ़वार के लिये हानिकारक होते है। उचित जलनिकास होने पर भूमियों में अणुजीवियों की क्रियाशीलता बढ़ती है जो कि फसल वृद्धि के लिये अपरोक्ष रूप में

लाभदायक होती है। जलनिकास की सुविधा होने पर पौधों के खाद्य तत्वों का भूमि में निक्षालन की क्रिया द्वारा कम ह्रास होता है। जलनिकास होने पर भूमि का तापक्रम भी अधिक नहीं गिर पाता जो फसलों की वृद्धि में सहायक होती है एवं भूमि दलदली होने से बच जाती है।

Silkworm as human food

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Abstract

Silkworm provides a potential source of human food especially to the poor tribal people and forest dwellers residing in close proximity of forests. Their nutritional values are astonishingly high, containing large quantities of proteins, fats, carbohydrates and vitamins. The present article describes the different silkworm species eaten by aboriginal people of the world with special reference to India.

Key words: Silkworm, India, tribal food, nutritive value

Introduction

Silkworm is the gift of god. Silkworms provide not only silk fibre but also food to the human beings (Roychoudhury and Joshi 1995). In many parts of the world, silkworm is exploited as a food source. In the silk producing countries of Asia, the dried larvae and the pupae are eaten. In Africa, the mature larvae of saturniids are collected and sold live in the markets for human consumption. They are eaten row, dried or powdered or used as a garnish in stew. In Western United States, the aboriginals of California and Oregon use to collect and consume the pre-pupa and pupa. The dried product is called 'peoggie'. The dried larvae are frequently used in stews, sometimes pupae too are roasted and consumed. Silkworm is considered as best preferred insect as food by tribal around the world, including India. The present article deals with these aspects.

Silkworm as edible insects

Bristowe (1932) has mentioned in his comments that silkworm pupae are eaten by the Chinese. Silkworm pupae are a by-product of reeling industry. It is estimated that in case of mulberry silkworm, *Bombyx mori* Linn. (Lepidoptera: Bombycidae), annually 1.5 lakh m.t. of pupae are produced in India which is generally a waste material, otherwise. In some parts of India and China, the mulberry silkworm pupae are regarded as delicious food and are extensively eaten when the silk has been reeled off. The pupae are either cooked in very hot water or roasted. It is a delicacy to tribals in some parts of north-eastern states of India. The fleshy larvae, pre-pupae and pupae of non-mulberry silkworms (Lepidoptera : Saturniidae), such as muga silkworm, *Antheraea assama* Westwood, tropical tasar silkworm, *A. mylitta* Drury and wild tropical tasar silkworm, *A. paphia* Linn., temperate tasar silkworm, *A. proylei* Jolly, wild silkworm, *Attacus atlas* Linn. and eri, *Samia ricini* Boisduval (Fig. 1) and Indian moon moth, *Actias selene* (Hubner) are preferred as food by Garo, Mikir and Khasi tribes of India (Joshi et al., 1993). They are in high demand in local markets of north-eastern states of India.

Fig. 1. Silk culture and forestry (source: Rana et al., 2003)

The rearing and production of eri silk is performed traditionally by the tribal communities of Assam, India (Choudhuruy 2003). It is important to note that the tribal communities rear eri silkworm mainly for two purposes, for obtaining silk for clothing and to consume pupae as a delicious food item. In this respect, eri pupa is not a waste product while mulberry and muga pupae are obtained as waste material after processing and reeling the cocoon. In fact, eri pupa can be taken out from the cocoon in live condition without affecting the quality and quantity of silk. The live and fresh pupae are consumed by tribal people of north-east India.

Food value of silkworm

Biochemical findings reveal that silkworm pupae are highly nutritious and possess real food value. The detailed chemical constituents of pupae of mulberry silkworm, *B. mori* have been reviewed by Yokoyama (1962). The data on these aspects revealed that mulberry silkworm pupae contain water, protein, fat, glycogen, chitin, ashes and others in the proportions of 7.18, 48.98, 39.57, 4.66, 3.37, 2.19 and 1.70% in dried pupa; 6.34, 60.77, 15.30, 5.78, 4.63, 2.73 and 4.57% in pressed pupa and 5.49, 72.82, 0.47, 6.92, 5.55, 3.27 and 5.48% in pupa after silk extraction. Deoiled pupa is also a valuable source of amino acids, particularly for essential amino acids. The composition of amino acid mixture in deoiled pupa protein are glycine (14 mg/g), aspartic acid (21mg/g), glutamic acid (5 mg/g), serine (5 mg/g), threonine (7 mg/g), alanine (0.094 mg/g), lysine (5 mg/g), arginine (19 mg/g), valine+methionine (199 mg/g) and leucine+isoleucine (500 mg/g). Further, the mulberry silkworm pupae are also rich in vitamins, viz. vitamin B12, nicotinic

acid, folic acid and vitamin D. The fatty acid composition varies during developmental stages but lionolenic acid is predominant throughout, amounting approximately one-third of the total fatty acids (Nakasone and Ito, 1967). All these indicate that mulberry silkworm pupae are rich in biochemical compositions which are of vital need to the human beings.

The chemical compositions of pupae of eri silkworm, *S. ricini* have been published by Choudhury (2003). The main constituents are found to be 62% crude protein, 44 % soluble protein, 25% total lipid and 5.2% ash content in dry eri silkworm pupae. The lipid or oil content of eri pupae is very high. This can be extracted from dry pupae powder by solvent extraction method. By using petroleum ether as solvent, it is found that extractable oil in dry pupae is 19.45% whereas the use of n-hexane shows the amount to be 21.47%. Some important characteristics of eri pupae oil are refractive index 1.47 at 30^0C, acid value 67.37, saponification value 150.88, iodine value 174.91 and cholesterol 0.36%.

Although often people say that consumption of eri silkworm as a 'filthy' practice, intermittent research has proved that it makes nutritious feeding. Singh and Suryanarayana (2003) have mentioned that analysis of eri silkworm exhibits high amount of protein (55-60% crude protein), total lipids (26%) and free amino acids (5-8%). Hundred grams of dried eri silkworm provide 75% of the average individual daily protein requirement and 100% of the daily requirement of many vitamins (pyridoxal, riboflavin, thiamine, ascorbic and folic acids and minerals (calcium, iron and phosphorus). In terms of protein, fat, vitamins and calorific value, eri silkworms are compatible to meat and fish. Besides a certain degree of indigestibility, common with any living thing with an exoskeleton of the body, eri silkworms contain large amounts of crunchy chitin and their consumption can substantially supplement preferably cereal diet of poor tribal people.

Eri silkworm diet and income generation

The larvae of eri silkworm, *S. ricini* is fatty and less spiny. It is bluish or yellowish in colour and moulted with black markings. It does not immediately occur to mind as food, but is better known as the ugly creature. It is more than a gimmick to grace the starters menu in tribal's dining table in the north-east India. For many tribals of Tibeto-Burman and Indo-Mongoloid origin, mostly the Rabhas, Bodos, Abor, Miri, Kachari, Garos, Khasi, Naga, Adis, Mizos and the Syntengs inhabited in the region, it is a great delicacy and dietary staple (Singh and Suryanarayana 2003).

Generally, the first generation of eri cocoons is harvested by the end of March. The second generation, from eggs laid in early April, is harvested in May. During harvesting period of two seasons, from sunrise to sunset for two to three days, one can find the rural women busy in taking out the pre-pupae through the open mouth of the silken cocoon. Such pre-pupae have atrophied gut and the gut contents are no more available due to initiation of larval-pupal metamorphic changes. Mostly in the evenings, they boil the pre-pupae and keep outside for drying. The methods vary from place to place. In Nagaland, Meghalaya and Karbi Anglong areas of Assam, the pre-pupae are dried and smoked in ash and hot coal (Singh and Suryanarayana 2003). In other areas, pre-pupae are boiled in salt water and then semi-dried. The product looks like blackened pea nuts/cashew nut,

Fig. 2. Eri silkworm dishes (source: Singh and Suryanarayana, 2003)

curled and dry and is palatable as peanut shells.

In Assam, traditionally, harvesting, processing and sale of eri pre-pupae and pupae is very common. However, its trade has become increasingly commercial. North eastern region of India is main consumer of eri pre-pupae and pupae. These are also available in local markets in live condition and sold in plastic bags by weight. They can be eaten dry as crisp or hydrated again and served as stew or fried. Marketing surveys found that rearers get good economic return under the present practice of edible production of pre-pupae and pupae of eri silkworm.

A report mentioned by Singh and Suryanarayana (2003) on "preparation of delicious food from eri silkworm pre-pupae, pupae and fertilizer from its excreta" based on a study in small traditional sericulture village Khumtai, Golaghat district of Assam. In this village, there are 240 families are residing, out of which 140 families are rearing eri silkworm. Due to rearing of ericulture, rearers are getting income from three sources, such as from eri spinning-48%, from eri pre-pupae and pupae-37% and from eri waste-15%. The different items of cuisine that can be prepared out of eri pre-pupae and pupae include fry, pakori, chop, cake, etc. (Fig. 2). All these would ensure additional income for the eri rearer and render ericulture more attractive,

Conclusion

Thus, it is clear that silkworm serve as human food particularly as tribal delicacy, which in turn, helps in the socio-economic upliftment of the forest dwellers who are mostly the poor and tribal people. According to van Huis et al. (2013), edible insects have always been a part of human diets, but in some societies there remains a degree of disdain and disgust for their consumption. Silkworm offers a vast opportunity to merge old traditional knowledge and modern science to improve

human food security and safety worldwide.

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Wind disaster: A threat to rubber plantations of Tripura

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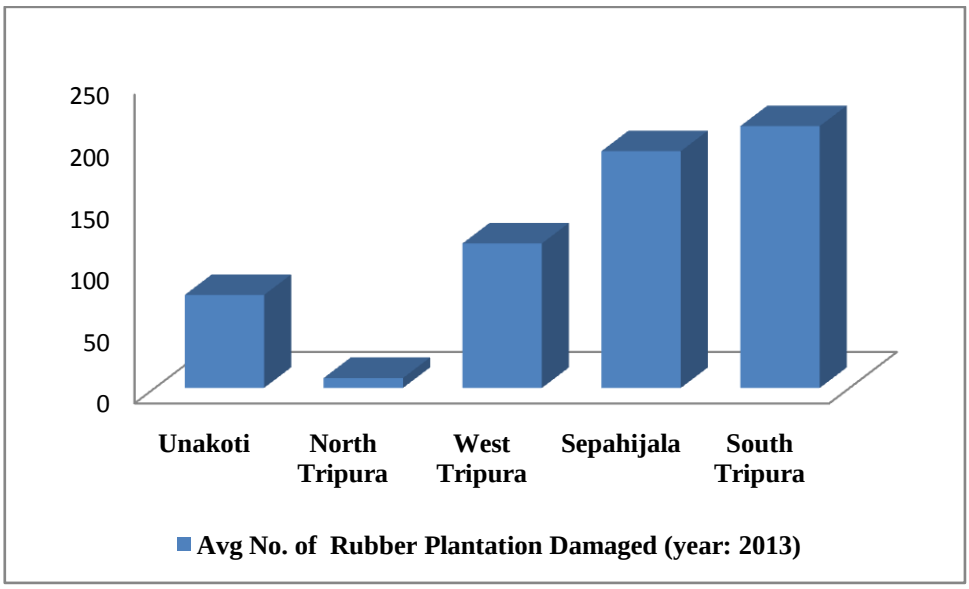
Wind disaster due to tropical cyclone and other different natural calamities are the most tremendous natural disaster faced by rubber industry. The intensity of cyclone is not only the impact factor but also other factors like cyclone route; landing location; area surface topography and the condition of rubber plantation also have major roles. The topography has a diverse effect on the wind power as the slope and the slope position may cause great variation in the wind damage. Therefore the effect of topography cannot be overlooked in case of wind damage of rubber plantation as our hilly state Tripura has an undulating topography. According to some investigation and research wind disaster to different rubber plantations are different it may be due to wind resistance of the specific rubber species, its planting mode, planting density, shaping and pruning etc. like cyclones mainly damage the rubber trees that are shallow rooted. The rubber tree may grow to a height of about 30 metres and after 7 years it starts yielding latex and after this gestation period, the trees are ready to tap. Rubber deals in different forms and raw material such as ribbed smoke sheet, estate brown crepe, centrifuged latex and skim crepe are also used. In Tripura people are well aware of wind disaster that had caused huge economic loss to perennial crop like rubber which usually takes place during the month from April to July in almost every year in the form of cyclones.

In April 2014, a total of 1450 houses were damaged and a large population was displaced from their homes due to the cyclone in North Tripura and other parts of Tripura. In June 2015, about 200 families were displaced from their houses in Ambassa sub-division of Dhalai district and many trees and electric posts were uprooted due to the storm over night. A total of 250 houses were totally damaged and more than 1000 houses partly damaged due to the cyclone and hailstorm over night at Lakkhipur village under Jirania subdivision of West Tripura district, in March 2016. 200 families were evicted from their houses from two villages — Shabdakarpara and Bongshipara and they took shelter in government buildings near Jirania.



Source: www.tripurarubber.in

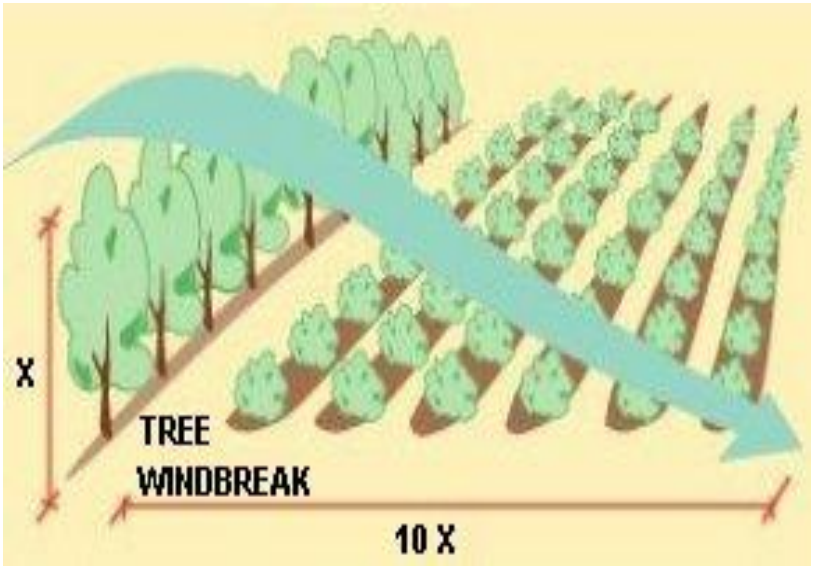
From several reports it is clear that due to cyclone damage productive and matured rubber plantations are the major victims in different districts of Tripura. As it is well aware fact that it takes 7-8 years to grow rubber trees to be a productive one but when the loss occurs the growers can't fill with new seedlings in the middle of the mature rubber plants as new rubber seedling will not grow. So, what the growers loose is lost from their regular return. The growers can't utilize the space created due to loss of matured trees for other purpose as the thick canopy surrounding of rubber trees would prevent any new species or new rubber seedlings to come up which may eventually affect the long term economic goal of the farmer. Rubber being a long term perennial crop which remain productive for a longer period (nearly 30 years of economic life) and also takes 7-8 years for achieving its productive stage. So, when a mature and productive rubber tree which is about to be used for tapping or already providing latex, falls by any wind disaster like cyclone then it is a cumulative loss to the rubber plantation owner.

The most effective and popular method of protecting the rubber plants from cyclone is through windbreaks of certain tree species in North and South direction or in the border lines surrounding the whole rubber plantation. Windbreak**,** by hearing

the word we can understand that it is mainly used to break the wind-flow and reduce wind speed. Windbreaks and shelterbelts are barriers planted on borders of farm plots that help to slow down the speed of wind. Usually consisting of trees and shrubs, they also may be perennial or annual crops, grasses, wooden fences, or other materials, which are used to provide a protected environment to save the plantation from damage by strong wind disasters like cyclones etc. And thus, windbreaks help for obtaining higher yields and also to control erosion and protect from blowing snow, provide habitat for wildlife and tree products and improve landscape aesthetics.

According to insurance policy in rubber board, the board would pay certain amount of money for damage on per plant basis considering the age of the plantation.

The coverage for rubber trees of 6-7 years is said to be Rs. 625/- per plant. That means when a 6-7 years old rubber tree is damaged, the grower will get Rs. 625/- following certain guidelines.



When a grower loose more than 200 numbers of matured rubber trees he can't even decide what is to be done to recover from the loss. For example, out of total 650 nos. rubber trees, 200 trees are damaged due to cyclone and rest remains 450 trees; but, in the scenario of dwindling income, it is difficult for a farmer to restore the growing stock. Moreover, if the damage is distributed in the entire plantation then growers become helpless to take up new plantation and then they have to live with economic misery. (Source: www.tripurarubber.in)

In this context windbreaks may be beneficial as they cause -

1. Reduction in soil erosion form wind.
2. Protects plants from wind damages.
3. Alter microenvironment for enhancing plant growth.
4. Conserves soil moisture.
5. Provides shelter for structures, livestock and recreational areas.
6. Enhance wildlife habitat by providing travel corridors.

Moreover the plantation owner can plant economically important plants like Sal, Sagon, Mango, Jackfruit, Broomgrass, Nageshwar, Coconut tree etc including bamboo also to raise a multipurpose Windbreak. As bamboo being a fibrous plant it may give protection as a border line plantation in the multiline windbreaks and as a bi-product bamboos may be harvested sustainably for making furniture, crafts and also for construction of bamboo houses.

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