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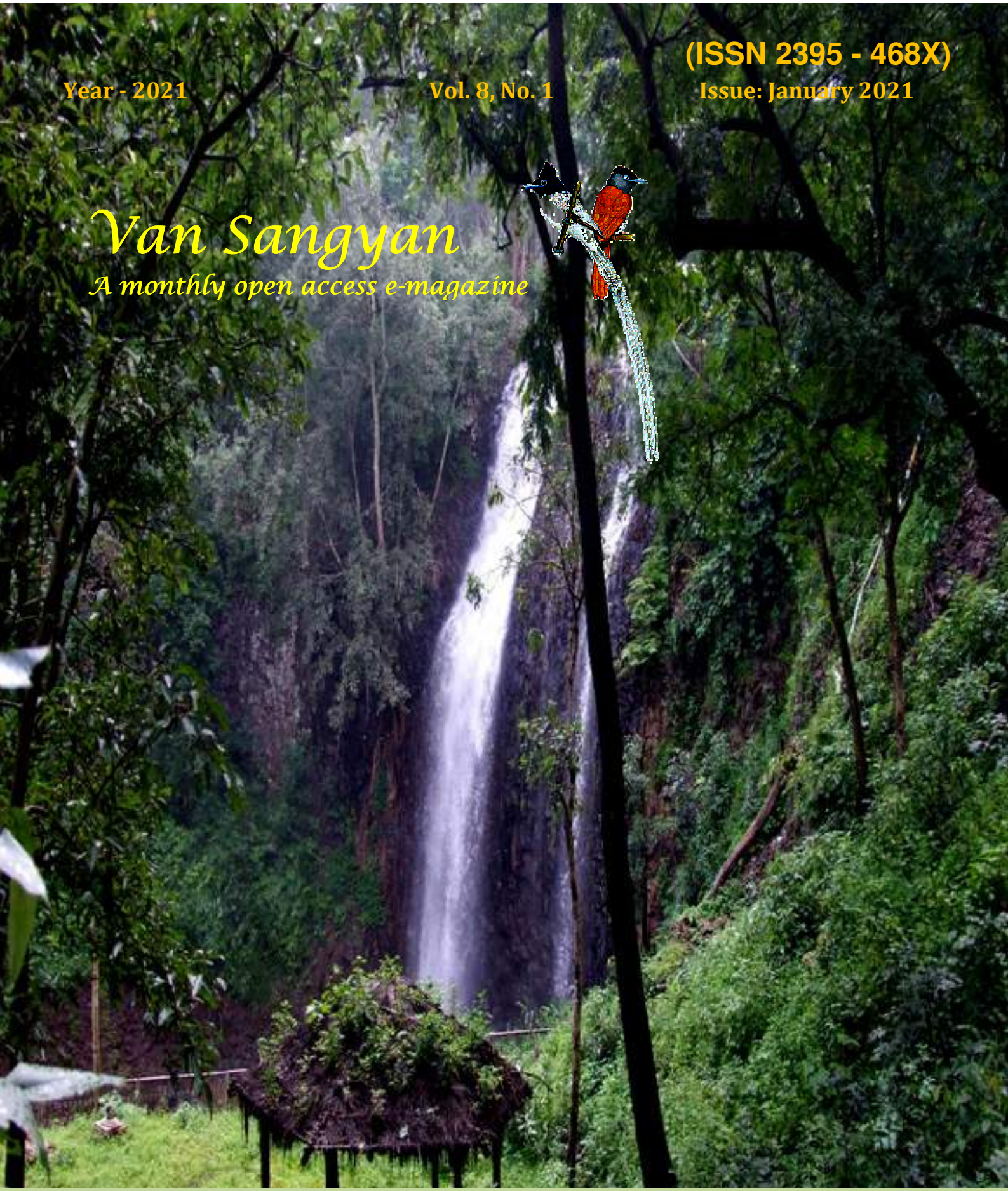

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Van Sangyan

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

Forests are the biggest users of water worldwide and extensive forested areas have been lost or are undergoing conversion to agriculture, creating concerns about loss of hydrological functions and increasing the competition for scarce water between agriculture, urban centres, industries and wildlife. The challenge is to improve the sustainability and productivity of land and water use, especially for the growing populations of many developing countries.

Agroforestry offers one promising option for efficient and sustainable use of land and water. In simplified terms, agroforestry
means combining the management of trees with productive agricultural activities. Agroforestry provides opportunities for forest conversion in the true sense of the term –that is, replacement of natural forests with other tree-based land-use systems. There are also opportunities to use agroforestry for the prevention or reversal of land degradation in the humid tropics .There are numerous potential benefits that agroforestry systems can achieve, ranging from diversification of production to improved natural-resources utilization.

It is often assumed that appropriate agroforestry systems can provide the environmental functions needed to ensure sustainability and maintain microclimatic and other favourable influences, and that such benefits may outweigh the disadvantages of a more complicated management . Secondly, it is also assumed that agroforestry might be a practical way to mimic the structure and function of natural ecosystems, since components of the latter result from natural selection towards sustainability and the ability to adjust to perturbations . Recent reviews of agroforestry findings, however, have highlighted several unexpected but substantial differences between intensive agroforestry systems and their natural counterparts that would limit their adoption for solving some of the critical land-use problems in the tropics. The most intractable problems for agroforestry appear to be in thesemi-arid tropics.

In line with the above this issue of Van Sangyan contains an article on कृषि-वानिकी में जल प्रबधंन. There are also useful articles viz.. Menace of Parthenium Hysterophorus on agroecosystems and its control measures, जैविक खाद एंव नीम खली वानिकी प्रजातियों की पौध वृद्वि के लिए लाभदायक. Effect of pruning on wildlife and micro-organisms, Role of nutrient cycling in forest ecosystems, and Mahogany shoots borer, Hypsipyla robusta and its control measures.

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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Contents **Page**

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कृषि-वानिकी में जल प्रबधंन

अजीत विलियम्स

बैरिस्टर ठाकुर छेदीलाल कृषि महाविद्यालय एवं अनुसंधान केन्द्र,

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परिचय

कृषि-वानिकी शब्द का उपयोग सामूहिक रूप से ऐसी सभी भूमि उपयोग पद्धतियों के लिये किया जाता है, जिसके अन्तर्गत काष्ठीय बहुवर्षीय वृक्ष योजना के अनुसार एक ही स्थान में फसल और/या पशुपालन एक साथ किये जाते हैं। इन्हें एक ही समय में समन्वय के साथ या एक के बाद दूसरा एक निश्चित क्रम से अपनाया जाता है।

कृषि तथा वानिकी भारत में भूमि उपयोग की दो प्रमुख पद्धतियां है, जो क्रमशः 46.2 प्रतिशत तथा 21.67 प्रतिशत भूमि क्षेत्र में अपनाई जाती है। यदि कृषि-वानिकी, कृषि और वानिकी दो विज्ञान से मिलकर विकसित की गई है, तो इसे समझने के लिये कृषि और वानिकी का ज्ञान ही पर्याप्त है, वस्तुतः ऐसा नहीं हैं। वन केवल वृक्षों का समूह ही नहीं है, मनुष्य का शरीर केवल रासायनिक तत्वो का समूह ही नहीं है कुछ और भी है। इसी प्रकार कृषि-वानिकी, केवल वानिकी और कृषि का मेल नहीं है, कुछ और भी है। कृषि और वानिकी दोनों ही भारत की प्राचीन पद्धतियां हैं, तथापि कृषि-वानिकी, एक ऐसा विज्ञान है जो कृषि, वानिकी, पशुपालन, मछली पालन तथा अन्य विषयों और प्रबंधन पर आधारित है, जो सब मिलकर भूमि उपयोग की सुव्यवस्थित पृष्ठ भूमि का निर्माण करते हैं।

कृषि-वानिकी क्या हैं ?

कृषि-वानिकी, भूमि उपयोग की वह धारणीय पद्धति है, जिसके अंतर्गत भूमि की उत्पादकता बनाये रखते हुये उस भूमि पर वृक्षों तथा फसलों का उत्पादन और या पशुपालन, एक ही समय में या क्रमबद्ध रूप में अपनाया जाता है, जो जन-समुदाय की आवश्यकताओं की पूर्ति तथा पारिस्थितिकीय संतुलन को बनाये रखें।

अथवा

कृषि-वानिकी भूमि प्रबधन की ऐसी पद्धति है जिसके अंतर्गत एक ही भू-खंड पर कृषि फसलों और बहुउद्देशीय वृक्षों के उत्पादन के साथ-साथ पशुपालन भी किया जाता है । कृषि वानिकी से भूमि की उपजाऊ शक्ति को बढ़ाया जाता है। सीधे शब्दों में फसलों के साथ वृक्ष फलदार, इमारती, ईधन वाले उगाने की पद्धति को कृषि वानिकी कहते हैं कृषि-वानिकी पद्धति से भूमि का उपयोग बढ जाता है तथा फसल उत्पादन में होने वाले जोखिम घटने लगते हैं ।

कृषि -वानिकी के मुख्य उद्देश्य

कृषि-वानिकी के मुख्य उद्देश्य निम्नलिखित है-

(1) कृषि उत्पादन को सुनिश्चित करना एवं खाद्यान्न को बढ़ाना।

(2) मृदा क्षरण में नियंत्रण।

(3) भूमि सुधार।

(4) ईंधन एवं इमारती लकड़ी की आपूर्ति करना।

(5) कुटीर उद्योगों को बढ़ाने के लिये अधिक साधन जुटाना एवं रोजगार के अधिक अवसर प्रदान करना।

(6) पर्यावरण की सुरक्षा।

(7) पशुओं के लिये साल भर अच्छे गुण वाले चारे प्रदान कर उनकी उत्पादन क्षमता को बढ़ाना।

(8) ऊसर एवं बीहड़ भूमि का सुधार करना।

(9) फलों के उत्पादन को बढ़ाना।

(10) जलाऊ लकड़ी की आपूर्ति करके गोबर को ईंधन के रूप में प्रयोग करने से रोकना तथा इसे खाद के रूप में उपयोग करना।

संक्षेप में कृषि-वानिकी का मुख्य उद्देश्य कोई विशेष लागत लगायें बिना ग्रामीण लोगों की आर्थिक स्थिति में सुधार लाना है। इसको लगभग हर तरह के भूमि पर उपयोग में लाया जा सकता है। भूमि-वर्गीकरण के आठ वर्गो में कृषि-वानिकी को सभी वर्गो वाली भूमि पर थोड़ी बहुत फेरबदल के साथ लाभकारी ढ़ग से अपनाया जा सकता है।

कृषि-वानिकी में जल प्रबन्धन

सिंचाई की उपयुक्त विधि का चुनाव

कृषि-वानिकी के अन्तर्गत कृषि फसलों एवं वानिकी वृक्षों में जल उपयोग क्षमता एवं अन्य लाभों को बढ़ाने के लिये यह आवश्यक है, कि उपयुक्त सिंचाई विधि का चुनाव करें। सिंचाई की विधि के चुनाव को निम्नलिखित कारक प्रभावित करते है-

(1) भूमि के गुण।

(2) पौधों की बढ़वार की प्रवृत्ति व जल की आवश्यकता।

(3) सिंचाई के स्त्रोत का आकार।

(4) सिंचाई के जल के गुण।

(5) मौसम की दशा।

सिंचाई का समय

जब पौधों की वृद्धि में मिट्टी में उपलब्ध नमी की कमी के कारण महत्त्वपूर्ण कमी आना शुरू हो जाये तभी सिंचाई करनी चाहिये। कृषि-वानिकी में सिंचाई करने का अनुमान निम्नलिखित तथ्यों के आधार पर ही लगाया जा सकता है -

(1) पौधों की बाहरी दशा देखकर।

(2) मिट्टी के गुण।

(3) मृदा नमी की माप।

(4) पौधों के जीवन में क्रान्तिकारी अवस्थाओं पर।

सिंचाई की उपयुक्त विधियां

जल एक अमूल्य निधि है और इसके अभाव में कृषि-वानिकी कार्य असंभव है। हमें जल के महत्व को समझकर इसके अपव्यय को रोकना चाहिये। जल का उचित उपभोग तथा अपव्यय को कम करने हेतु जिन उपायों को किया जाता है उसे जल प्रबंधन कहते है।

साधारणतया कृषि-वानिकी में क्यारियों तथा वृक्षारोपण क्षेत्र में जल जिन पद्धतियों से दिया

जाता है उसके अन्तर्गत मुख्य रूप से निम्न विधियां है -

(1) पृष्ठीय सिंचाई

(अ) बाढ़कृत या आप्लावन या तोड़ विधि -

(1) असीमित मुक्त बाढ़कृत

(2) सीमान्त पट्टी या नकवार या सारा सिंचाई विधि

(3) क्यारी या पट्टी विधि

(4) बेसिन या रिंग या थाला विधि

(ब) कूड सिंचाई विधि -

(1) गहरी कूड सिंचाई विधि

(2) समोच्च कूड विधि

(2) अधो-पृष्ठीय सिंचाई

(3) बौछारी सिंचाई विधि

(4) टपकाव या ड्रिप ट्रिकिल सिंचाई विधि

उपरोक्त विधियों में (3 व 4 को छोड़कर) हमें काफी अधिक मात्रा में जल की आवश्यकता होती है तथा अपव्यय एवं बहाव भी अधिक होता है। जल प्रबंधन के तहत् हमें यह देखना चाहिये कि जल की मात्रा तथा उसका अपव्यय कम हो। इस दृष्टि से बौछार पद्धति एवं टपक पद्धति काफी लाभदायक सिद्ध हुई है। अतः हमें रोपणी एवं वृक्षारोपण क्षेत्र में इन विधियों द्वारा सिंचाई करना चाहिये। यद्धपि ये विधियां मंहगी है पर इनके कई लाभ है तथा सबसे महत्वपूर्ण बात यह है कि इन विधियों से जल का अनुचित बहाव या व्यय रूकता है और अधिक से अधिक मात्रा में जल पौधों की जड़ों तक पहुंचता है।

कृषि-वानिकी में जल प्रबंधन की मुख्य विधियां

बौछार पद्धति

इस विधि में जल को वर्षा की तरह फुहार रूप में पौधों को दिया जाता है। इस विधि की विशेषता यह है कि पौधों को वर्षा का आभास होता है, पौधे एवं पत्तियां धुल जाती है जिससे प्रकाश संलश्sषण की क्रिया अधिक होती है। इस पद्धति में जल की मात्रा कम लगती है तथा जल समान रूप से वितरित होता है। व्यर्थ बहाव कम होने के कारण मिट्टी का क्षरण भी कम होता है। घुलनशील उर्वरक, कीटनाशक तथा अन्य पौधवर्धक रसायनों का आसानी से छिड़काव किया जा सकता है। इस विधि द्वारा सिंचाई से पाला तथा ग्रीष्म ऋतु में पौधों को बचाया जा सकता है।

बौछारी पद्धति के निम्न भाग होते है -

पम्पिंग सेट

यह जल का उदवहन कर ताकत के साथ पाइप लाइन में भेजने का कार्य करता है।

सहायक लाइन

ये अस्थाई होती है। इनका उपयोग विशेष स्थलों तक जल पहुंचाने के लिए किया जाता है, जैसे उद्यान, पौध शाला आदि।

कपलर

इनका उपयोग मुख्य पाइप लाइन तथा सहायक

पाइप लाइनों और नॉजल को जोड़ने के कार्य में होता है।

स्प्रिंकलर हैड

इससे जल ताकत के साथ फुहारे के रूप में निकल कर दूर तक फैलता है। ये एक या दो एक साथ हो सकते है। ये स्थायी या घूमने वाले होते है।

ड्रिप (टपक) सिंचाई विधि

जल ही जीवन है इस तथ्य से सभी परिचित है। रोपण क्षेत्र में जल के बिना कुछ भी संभव नहीं है, अतः सीमित जल स्त्रोतो के रहते हमें जल को व्यर्थ बहाव को रोकनें एवं जल के सदुपयोग पर ध्यान देना पड़ेगा। परंपरागत सिंचाई पद्धति से जल का व्यर्थ बहाव तो होता ही है साथ ही मिट्टी की उपजाऊ उपरी सतह का क्षरण भी होता है। वाष्पीकरण एवं रिसाव से जल की लगभग 50 प्रतिशत मात्रा नष्ट हो जाती है। ड्रिप (टपक) सिंचाई विधि सिंचाई की आधुनिकतम विधियों में से एक हैं।

यह सिंचाई की नवीनतम पद्धति है तथा इस विधि से पौधों को निश्चित मात्रा में कम से कम अंतर से जल दिया जाता है। इस विधि में वाष्पन, वाष्पोत्सर्जन को छोड़कर अन्य कारणों से जल का व्यय नहीं होता है।

इस विधि से जल का गहराई में प्रवेश होता है और जल के वाष्पीकरण तथा बहाव को कम किया जा सकता है। फलस्वरूप 50 से 70 प्रतिशत तक जल की मात्रा बचाई जा सकती है। इस विधि से रासायनिक खादों को पानी में मिलाकर पौधों तक पहुचाया जा सकता है। इस प्रकार के प्रयोग से मजदूरी खर्च में बचत तो होती ही है साथ ही उपज में 30 प्रतिशत तक की वृद्धि प्राप्त की जा सकती है।

ड्रिप (टपक) सिंचाई विधि का प्रयोग लगभग सभी प्रकार के फसलों, उद्यानिकी फसलों एवं वानिकी वृक्षों में सफलता पूर्वक किया जा सकता है। फलदार वृक्षों की तरह अनेक प्रकार के वानिकी वृक्ष जैसे नीम, नीलगिरी, पोपलर, खम्हार, सागौन आदि की सिंचाई के लिए यह विधि उत्तम है। ड्रिप (टपक) सिंचाई विधि हर प्रकार की मिट्टी जैसे रेतीली एवं काली मिट्टी में भी सफल सिद्ध हुई है। कम वर्षा वाले क्षेत्रों के लिए तो यह विधि वरदान सिद्ध हुई है। ठण्डे प्रदेशों में भी इसका प्रयोग सफलता पूर्वक किया जाता है।

उपरोक्त लाभ के अलावा ड्रिप (टपक) सिंचाई विधि की कई अन्य विशेषताएं भी है जो निम्नलिखित है-

1- इस सिंचाई विधि द्वारा पौधों की जडों में आवश्यकतानुसार पानी निर्धारित दर से दिया जा सकता है जिससे पौधों की अच्छी वृद्धि होती है।

2- महँगे रासायनिक खाद व अन्य रसायनों का प्रयोग वांछित गहराई तक किया जा सकता है तथा इनके अनावश्यक बहाव को रोका जा सकता है।

3- पौधों की बढ़वार तेज तथा फल शीघ्र व समरूप लगते है।

4- ग्रीन हाउस तथा नर्सरी में भी टपक सिंचाई का प्रयोग सुगमता से किया जा सकता है।

5- पौधा ओजस्वी एवं स्वस्थ रहता है।

ड्रिप संयत्र के मुख्य अवयव

1- विद्युत मोटर

2- सेन्ड फिल्टर

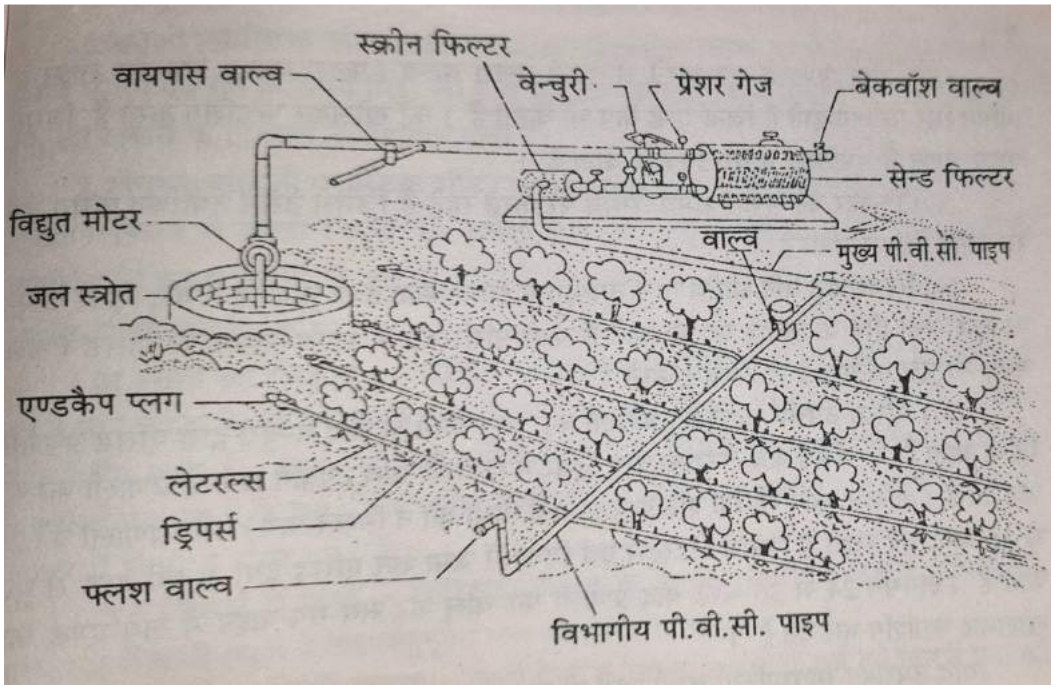
3- स्क्रीन फिल्टर

4- प्रेशर गेज

5- वेन्चुरी

6- विभागीय पी.वी.सी. पाइप

7- लेटरल्स



मल्चिंग

पौधो के आस-पास तथा तने के चारों ओर की भू-सतह को किसी उपयुक्त सामग्री जैसे पुआल, घास, पत्ती या प्लास्टिक शीट द्वारा ढकने की प्रक्रिया को मल्चिंग कहते है ं इसका मुख्य उददेष्य मृदा की सतह से वाष्पोत्सर्जन से होने वाली नमी के नुकसान को कम करना, खरपतवारों की वृद्धि को रोकना तथा पौधों को दिये जाने वाले खाद व पोषक तत्वों की पूर्ण उपलब्धता प्रदान करना है।

प्लास्टिक मल्चिंग

विशेष रासायनिक गुणधर्म के तहत बनी प्लास्टिक शीट (फिल्म) जिनमें मुख्यतः कम घनत्व वाले पॉलीथीन (एल.डी.पी.ई), इथलीन

विनाइल एसीटेट (इ.व्ही.ए.) तथा अधिक घनत्व वाले पॉलीथीन (एच.डी.पी.ई) पालीविनाइल क्लोराइड (पी.व्ही.सी.) एवं पाली प्रापलीन (पी.पी.) आदि का उपयोग जब मल्चिंग के लिये किया जाता है तो उसे प्लास्टिक मल्चिंग कहते है। इस प्रक्रिया में प्लास्टिक शीट द्वारा पौध क्षेत्र की मृदा को ढक दिया जाता है। मल्चिंग से मृदा में ताप क्रम की वृद्धि हो जाती है तथा एक ऐसे सूक्ष्म वातावरण (माइक्रोक्लाइमेट) का निर्माण हो जाता है, जिससे वहां की कार्बन डाईऑक्साइड में भी वृद्धि हो जाती है, जो कि पौधो की अच्छी बढ़वार के लिये उपयुक्त होती है। प्लास्टिक मल्चिंग हेतु मुख्यतः दो प्रकार की प्लास्टिक शीट का प्रयोग किया जाता है -

1. काली प्लास्टिक शीट
2. लगभग पारदर्शी प्लास्टिक शीट

काली प्लास्टिक शीट

काली प्लास्टिक शीट (फिल्म) से ठंडे मौसम एवं रात के समय मिट्टी की गर्मी सुरक्षित रहती है। ऐसी स्थिति पौधों की बढ़वार तथा खरपतवारों के नियंत्रण में सहायक होती है।

लगभग पारदर्शी प्लास्टिक शीट -

पारदर्शी फिल्म से काली फिल्म की अपेक्षा मृदा का तापमान ज्यादा अच्छा रहता है तथा पारदर्शिता के कारण रोशनी भी पार हो जाती है।

प्लास्टिक मल्चिंग के लाभ

नमी का संरक्षण

प्लास्टिक मल्चिंग से मृदा तापमान में वृद्धि होती है और पानी भाप बनकर उड़ता है, जो फिल्म के निचली सतह पर जम जाता है। फिर यह पानी बूंद बनकर मिट्टी में गिर जाता है। अतः मिट्टी की नमी बनी रहती है, जिससे पैदावार में बढ़ोतरी होती है। बिना प्लास्टिक मल्च के यह संभव नही हो पाता है और पानी वाष्प बनकर उड़ जाता है, जिससे पैदावार में विपरीत असर पड़ता है ।

सिंचाई में कमी

प्लास्टिक मल्चिंग के उपयोग से रोपण क्षेत्र में सिचाई की बारंबारता में कमी आती है तथा बहुमूल्य जल की हानि का बचाव होता है।

खरपतवारों से बचाव

काली (ब्लेक) मल्चिंग शीट से सूर्य की किरणें मृदा की सतह तक न पहुंचने के कारण खरपतवारों की वृद्धि काफी कम हो जाती है।

मिट्टी का सोलराइजेशन अर्थात धूप के पूर्ण गुण प्राप्त होना

प्लास्टिक मल्च फिल्म के प्रयोग से सूर्य की किरणों के गुण बेहतर तरीकों से मिट्टी में पहुंचते है फलस्वरूप सूक्ष्म जीवाणु, सूत्रकृमि व कवक आदि पौध क्षेत्र में नही पनप पाते है।

मिट्टी की सही संरचना रखने व अधिकतम कार्बन डाईऑक्साइड बनाये रखने में सहायक

प्लास्टिक मल्च (फिल्म) के प्रयोग से मृदा पर पानी की सीधी बौछार नही पड़ती है फलस्वरूप मिट्टी की नरम बनावट (छोटे छिद्रों वाली) बनी रहती है । इसके अलावा मल्च फिल्म के पास कार्बन डाईऑक्साइड गैस की ज्यादा मात्रा एकत्रित होती है, जो कि पौधों के प्रकाश संश्लेषण की प्रक्रिया में सहायक होती है ।

अधिक उत्पादन

मल्च के प्रयोग से उत्पाद की गुणवत्ता के साथ-साथ उत्पादन में भी वृद्धि होती है।

सावधानियां

मल्चिंग के लिये प्लास्टिक शीट का प्रयोग करते समय हमें कुछ बातों का विशेष ध्यान रखना चाहियें -

1. जब तेज हवा चल रही हो तब मल्च फिल्म न बिछायें इससे फिल्म के फटने की संभावना अधिक होती है।
2. मल्च फिल्म को किनारे से लगभग 10 से 15 से.मी. मिट्टी से ढक देना चाहिये ताकि फिल्म उस क्षेत्र में अच्छी तरह जमी रहें।
3. पौधे रोपण से पहले पट्टिका पर फिल्म बिछा ले तथा सुनिश्चित कर लें कि उसमें मिलावट न हों, उसके बाद पौधों हेतु निर्धारित दूरी पर फिल्म में छेद करने के पश्चात् छिद्रों पर रोपाई करें।
4. मल्च फिल्म को अत्यधिक गर्मी के समय न बिछायें।
5. पौधों के आच्छादन के कुल क्षेत्रफल के 40 से 60 प्रतिशत भू-भाग को मल्च फिल्म से ढकना चाहिये।
6. खेत में लगे वृक्षों पर मल्चिंग करना हो तो वृक्ष के तने की मोटाई के आकार का शीट में छेद करते है तथा फिल्म को एक तरफ से काटकर पौधे के तने के चारों ओर बिछा देते है।

Menace of *Parthenium Hysterophorus* on agroecosystems and its control measures

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Introduction

Parthenium hysterophorus L., globally known as feverfew, ragweed, kadvigha, carrot weed. It is most popularly known as 'congress grass' throughout India while in Hindi speaking belt known by the popular name of 'gajarghas' (carrot grass). It belongs to family Asteraceae. The genus name Parthenium is derived from the Latin word 'parthenice' a reference to the plant now known as *Tanacetumparthenium* (L.) Bernh. or 'fev erfew' the speciesname 'hysterophorus' was derived from the Greek word 'hystera' (womb) and 'phoros' (bearing), referring to the prolific seeding habit of the plant (Parsons and Cuthbertson 1992). It was first time reported from India in 1880 but recognized as a threat in 1955, Pune (Maharashtra) by Professor Paranjapeand introduced due to contaminated PL-480 wheat imported from the United States and Mexico.

Botanical description

It is an annual, erect,profuse branched and short lived herbaceous plant. Height varies between 50-150 cm, stem highly branched; leaf simple with profusely dissected leaflets; flower heads occur on a corymb, phyllaries 10 in 2 series, ovate, dull white, 3-4 mm in diameter; disc floret: numerous, dull white; stamen - 4, anther- exerted; ovary sterile; ray floret: found just opposite to inner phyllaries, only 5 ray florets per flower head, corolla obsolete, stamen-absent, stigma-parted, style short, ovary oval. Fruit cypsela, each flower head bearing 5 cypsela, flat and triangular in shape with thin, white, spoon shaped appendages (Maharjan, 2007). Parthenium weed is a prolific seed producer can produce from 15000 to 25000 seeds (Haselar, 1976; Joshi 1991).

Distribution

Parthenium is native to the area surrounding the Mexico, Central America, Southern North America, West Indies and Central South America. The spread and infestation of Parthenium are severe in some of the countries like Australia, South Africa, Ethiopia, India and Pakistan. In India, the weed is a serious problem in states like, Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Haryana, Karnataka,

Maharashtra, Madhya Pradesh, Punjab, Tamil Nadu and Uttar Pradesh; medium in Assam, Gujrat, Himachal Pradesh, Jharkhand, Jammu & Kashmir, Uttarakhand, Odisha, West Bengal and Rajasthan; low in Andaman & Nicobar, Arunachal Pradesh, Goa Kerala, Lakshadweep, Manipur, Mizoram, Meghalaya, Nagaland, Pondicherry and Sikkim. The weed has been rapidly spread in last twenty years and now it occurs widely along the roadsides, vacant land, disturbed sites, railway tracks sides, wastelands, water courses, agricultural crops, industrial areas, forest areas and even National parks etc.

Harmful Effects

i. **Effects on agriculture crops:** This weed has infested about 35 million hectares of land in India. Parthenium plant contains chemicals, like parthenin, hysterin, hymenin, and ambrosin. Presence of these chemicals, the weed exerts strong allelopathic effects on different crops. The weed also affects nodulation in several legume crops due to inhibition of activity of nitrogen fixing and nitrifying bacteria, namely, Rhizobium, Actinomycetes, Azotobacter and Azospirillum. In India, it causes a yield reduction up to 40% in agricultural crops.

ii. **Effect on forests ecosystem:** Earlier, it was not considered a weed of forests but now it has spread rapidly in these areas too. The invasion of Parthenium was reported in forest and wastelands with little or no growth of any other species and local bio-diversity was found to be threatened. Parthenium has been observed in many forest nurseries in Madhya Pradesh. The weed was observed in India at alarming rates by the author during 2010 and 2011 in Pench National Park in Madhya Pradesh. Parthenium has been found responsible to reduce grass availability to herbivores in Corbett National Park in Uttarakhand (India).

iii. **Effects on Animals**: All parts of the Parthenium plant at any stage of growth are toxic to animals. The major component which causes toxicity is 'parthenin' and other phenolic acids such as caffeic acid, vanillic acid, anisic acid, p-anisic acid, chlorogenic acid and parahydroxy benzoic acid which are lethal to human beings and animals. It causes anorexia, pruritus, alopecia, diarrhea and eye irritation in dogs. It also causes acute illness, when bittermilk and tainted meat from buffaloes, cows and goats are fed on grass mixed with parthenium. In addition, significant amount (10–50%) of this weed in the diet can kill cattle.

iv. **Effects on Human Beings:** The allergens found in this weed are parthenin, coronopilin, tetraneuris, and ambrosin. Pollens of parthenium cause asthma (allergic bronchitis), especially in children, adults and old age persons. Contact with any parts of the Parthenium plant (such as airborne pieces of dried plant material, pollen or even root) can cause the development of sensitivity as well as the subsequent risk of allergic reactions. Clinically, the Parthenium dermatitis are of three types, as discussed below:

a) The classical pattern, also known as Air Borne Contact Dermatitis (ABCD) affects the face, especially eyelids and/or neck, V of chest, cubital and popliteal fossae.

b) The Chronic Actinic Dermatitis (CAD) pattern involves the exposed areas such as forehead, rim of ears, cheeks, nape of neck, dorsae of forearms and hands as lichenifiedpapules, plaques or papulo nodules with relative sparing of non-sun exposed areas such as eyelids, retro-auricular areas and under surface of chin and depth of the skin folds.

c) The mixed pattern (combination of classical and CAD pattern) manifests as scattered infiltrated scaly papules over the exposed parts and dermatitis over eyelids, flexures of extremities and neck.

Control of Parthenium Weed

Various methods, e.g. physical, chemical, allelopathic cultural, biological and integrated, which are being practiced to manage this weed around the world as discussed below:

i. **Physical control**: This method is applicable in all type of ecosystems in limited area in spite of high cost involved. Manual uprooting of Parthenium before flowering and seed setting is the most effective method. Physical control involves hand weeding, a time consuming and unpleasant job, made worse by the health hazards involved with handling Parthenium weed. If uprooting is done after the flowering stage, the pulled out plants are to be burnt without transporting too far off places, to avoid seed dispersal.

ii. **Cultural control**: This method may be applicable in crop ecosystem. It has been observed that in some crop fields, Parthenium grows profusely. To reduce the seed bank in such crops, some fast growing species of fodders like barseem and sorghum can be taken to suppress Parthenium and its seed bank in the field.

iii. **Chemical control**: Chemical control is an effective method to control

Parthenium in the areas where its natural enemies are absent. Use of chemical herbicides, such as chlorimuron ethyl, glyphosate, atrazine, metribuzinand metasulfuron, are known to be very effective in controlling this weed. The application of 2,4-D EE (0.2%) and metribuzin (0.25 and 0.50%) was found more effective in controlling Partheniumat 15 days after spraying (DAS). The timing of chemical control is critical, which is sprayed before flowering in open waste lands, non-cropped areas, railway tracks and road sides.

iv. **Allelopathic control:** A study in India revealed that Cassia sericea reduces the accumulation of Parthenium by 70% and Parthenium population by 52.5% (KandasamyandSankaran, 1997). Another study showed that aqueous extracts from *Imperatacylindrical, Desmastachyabipinnata, Otcantiumannulatum* and *Sorghum halepense* markedly suppressed seedling growth and germination of Parthenium (Javaid*et al*., 2005).

v. **Biological control**: It has been considered most effective method against Parthenium in waste land, pasture, orchards and forest ecosystems by introduction of bio agent from the native place of the weeds under classical biological approaches. During last two decades, much emphasis has been given to control Parthenium through various biological agents like pathogens, insects and plants.

a) **Control of Parthenium through pathogens**: In India, there are many records of various pathogenic and non-pathogenic microorganisms on Parthenium. In spite of the presence of many pathogens, not all have been evaluated as biological control agents against the weed. In Australia, two rust species, *Puccinia abrupt* var. partheniicola (Jackson) Parmelee (winter rust) and *Pucciniaxanthii* var. *Partheniumhysterophorae* (summer rust) have established in the field, but their prevalence and impact is highly variable and sporadic, depending upon the local climatic conditions.

b) **Control of Parthenium through insects**: (a) By indigenous insects- In India, many insects have been reported on Parthenium but none of indigenous insect was found host specific yet. A cerembycidNupserha sp. was found to cause widespread damage (5-95%) to Parthenium. (b) By exotic insects: In India in 1983 at

Bengaluru, three insects namely defoliating beetle *Zygogrammabicolorata* Pallister, the flower feeding weevil *Smicronyxlutulentus*Dietz and the stem boring moth *Epiblemastrenuana* (Walker) were imported in India. *S. lutulentus* could not be multiplied in the laboratory while *E. strenuana* was found to complete its life cycle niger crop hence, its culture was destroyed. *Z. bicolorata* involved in controversy about its host specificity due to its occasional feeding on sunflower but after in depth studies under the supervision of Fact Finding Committee constituted by Government of India, the insect was declared safe and ban was lifted for its release.

c) **Control of Parthenium by competitive replacement through plants**: In a nationwide survey under coordinated project sponsored by Department of Biotechnology (DBT), India, plant species namely *Xanthium strumarium, Tephrosiapurpurea, Achyranthes aspera,Vitexnegundo, Cassia sericea, Cassia tora, Cassia spp*. and *Cannabis sativa* were found to be competitive against the weed.

vi. **Integrated Parthenium management**: It is clear indicate that Partheniumcannot be managed by adopting any single method. Integrated Parthenium Management (IMP) scheme involving the integration of all the available and low cost methods at different time of the year keeping in view the biology and germination of Parthenium. For example, manual removal involving public participation during rainy season when soil is wet and uprooting is easy, use of chemicals during winter and summer as spot treatment, use of botanical like *Cassia tora* and exotic insect *Z. bicolorata* during rainy season.

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जैविक खाद एंव नीम खली वानिकी प्रजातियों की पौध वृद्धि के लिए लाभदायक

ममता मेश्राम

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आमतौर हम देखते है कि किसान ज्यादा से ज्यादा अपनी फसल के उत्पादन को लेकर चिंतित रहा करते है। खेतों से अधिक उत्पादन प्राप्त करने के लिए तरह तरह रासायनिक एंव जहरीले कीटनाशक का उपयोग किया करते है इसका प्रभाव खाद्यान्य, मृदा स्वास्थ्य एंव पारिस्थितिकी तंत्र पर पड़ता है साथ ही भूमि की उर्वरा शक्ति शनैः शनैः नष्ट होती जाती है। मृदा की उर्वरा शक्ति को बनाये रखने के लिए प्रयोगो द्वारा यह पाया गया कि रासायनिक उर्वरकों के स्थान पर जैविक खादो का उपयोग अधिक लाभदायक होता है ।

पौधों की बढ़वार एंव अधिक पैदावार करने के लिए कृषि के साथ साथ कृषिवानिकी क्षेत्र मे भी जैविक खाद को अपनाने हेतु प्रोत्साहित किया जा रहा है। जैविक खेती से भूमि में जल धारण, उपजाऊ क्षमता की वृद्वि के साथ साथ भूमि की गुणवता में सुधार आता है। वर्तमान में कृषि के साथ साथ वानिकी में वर्मीकम्पोस्ट के प्रयोग पर बल दिया जा रहा है । वर्मीकम्पोस्ट, जिसे केचुआ खाद के नाम से जाना जाता है । केचुआ खाद से भूमि मे पाये जाने वाले नाइटोजन, पोटेशियम एंव फॉस्फोरस के साथ अति आवश्यक सूक्ष्म कैल्शियम, मैग्निशियम, तॉबा, लोहा, जस्ता, मोलिब्डयम और अधिक मात्रा मे जैविक कार्बन पाया जाता है। जैविक खाद के लाभदायक परिणामों को देखते हुए वानिकी प्रजातियों महुआ, बहेड़ा, हर्रा एंव भिलवा के पौध रोपणी अवस्था में इसका अध्ययन किया गया है। विभिन्न अनुपात मे जैविक खादों के साथ नीम की खली का प्रयोग कर महुआ, बहेड़ा, हर्रा एंव भिलवा के पौध रोपणी अवस्था में पौध वृद्वि दर का आंकलन किया गया ।

इसका प्रभाव देखने के लिए एक परियोजना ली गयी। इस परियोजना के तहत पॉलीथीन मे विभिन्न अनुपात मे गोबर खाद, वर्मीकम्पोस्ट के साथ नीम खली का प्रयोग किया गया। पॉलीथीन मे 2 किलोग्राम का मिश्रण रखा गया। इस मिश्रण

में महुआ, बहेड़ा, हर्रा एंव भिलवा के बीजों को रोपित किया गया। प्रत्येक प्रजातियों की जीवन प्रतिशत एंव पौध वृद्वि दर का आंकलन किया गया।

पॉलीथीन में गोबर खाद, वर्मीकम्पोस्ट के साथ नीम खली का मिश्रण निम्न अनुपात में लिया गया:

1. अनुपचारित अर्थात पॉलीथीन में मात्र कापू मिट्टी लिया गया है।
2. मिट्टी रेत एंव गोबर खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे मिश्रण लिया गया।
3. मिट्टी रेत एंव केचुअंा खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे मिश्रण लिया गया।
4. मिट्टी रेत एंव गोबर खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे 20 ग्राम नीम खली को डाला गया।
5. मिट्टी रेत एंव गोबर खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे 50 ग्राम नीम खली को डाला गया।
6. मिट्टी रेत एंव गोबर खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे 100 ग्राम नीम खली को डाला गया।
7. मिट्टी रेत एंव केंचुआ खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे 20 ग्राम नीम खली को डाला गया।
8. मिट्टी रेत एंव केचुअंा खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे 50 ग्राम नीम खली को डाला गया।
9. मिट्टी रेत एंव केंचुआ खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे 100 ग्राम नीम खली को डाला गया।

इस तरह अनुपचारित अर्थात मात्र कापू मिट्टी के साथ पौध वृद्वि का अंाकलन करते हुए उक्त अन्य मिश्रणों का पौध वृद्विके साथ तुलनात्मक अध्ययन किया गया एंव दो वर्ष के निरन्तर अध्ययन से यह पाया गया कि हर्रा प्रजाति के पौधों की वृद्वि मिट्टी रेत एंव केचुअंा खाद के अनुपात (1:1:1) मे 100 ग्राम नीम खली के साथ केवल कापू मिट्टी की तुलना में 165 प्रतिशत अधिक पायी गई। जबकि भिलवा में मिट्टी रेत एंव गोबर खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे 100 ग्राम नीम खली 146 प्रतिशत अधिक पायी गई, इसी प्रकार महुआ मे मिट्टी रेत एंव गोबर खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे 50 ग्राम नीम खली 140 प्रतिशत अधिक पायी गई जबकि बहेड़ा में मिट्टी रेत एंव केंचुआ खाद का अनुपात (1:1:1) के साथ पॉलीथीन मे 50 ग्राम नीम खली 132 प्रतिशत अधिक पायी गई।

इसी तरह उक्त उपयुक्त उपचारों में महुआ, बहेड़ा, हर्रा एंव भिलवा में केवल कापू मिट्टी की तुलना में 55 से 78 प्रतिशत तक अधिक पौध जिवित प्रतिशतता पायी गयी। उपरोक्त परिणामों से यह स्पष्ट होता है कि महुआ, बहेड़ा, हर्रा एंव भिलवा में पौधो की वृद्वि एंव जिवित प्रतिशतता में वृद्वि के लिए पॉलीथीन मे नीम खली का प्रयोग कॉफी सार्थक हुआ है । इसके साथ ही नीम की खली के प्रयोग से पौधों मे रोग प्रतिरोध क्षमता बढी है । पॉलीथीन मिश्रण के परीक्षण से यह ज्ञात हुआ है कि इन उपचारों से पौधे द्वारा नाइटोजन, फॉस्फोरस, पोटेशियम एंव कैल्सियम की पूर्ति हुई है ।

इन समस्त अवलोकन के पश्चात यह ज्ञात हुआ है कि केचुआं खाद गोबर खाद एंव नीम खली का उपयोग पौध वृद्वि के लिए कारगर है ।

Effect of pruning on wildlife and micro-organisms

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Introduction

Silviculture is thescience of controlling the growth, composition, quality and quantity of forest vegetation for the full range of forest resource .It considers habitat suitability for threatened or endangered species that need to be sustained while keeping a check on exotic invasive species. It manages the composition and structure of stands and landscapes to alleviate climate-related stresses and to enhance forest capacity. Enabling the indigenous forests to resist, tolerate and adapt to a dynamic environment (Peterson and Anderson2009).Successful silviculture depends on defined management objectives; most important of all is density management of stands.

Density management

Density management is a part of silvicultural system which balances the site resource availability and demand of stands.The management practices include; thinning of stands that decreasesthe relative humidity and creates unfavourable conditions for some pathogenic fungi. Saprobic fungi represent largest proportion of fungal species in forest soil. They perform a crucial role in the decomposition of structural polymers of wood, such as cellulose, hemicellulose and lignin, thus contributing to the maintenance of the global carbon cycle. They are also involved in biotic interactions that can be pathogenic, beneficial or neutral for plants and other such organism.It was studied that some pathogenic species such as,Armillaria and Heterobasidion of Kingdom Fungi cause bud and root rot in conifers of Northern Temperate forests, by degrading the lignin and cellulose components of wood.

As per the recorded fungal species, antagonists of Armillaria and Heterobasidionspp.

Includes;Mortierellales, Mucorales, P. adametzii, P. citrinum, P. janczewskii, P. spinulosum, T. geodes, and Trichodermaspp. These species of Basidiomycotainhibitthegrowth of Armillaria and Heterobasidion in (in vitro) paired cultures by; decreasing the extent of root rot caused by Armillaria and necrosis caused by Heterobasidionannosum on tree seedlings. Fungistatic antibiotics produced from these antagonistic fungi are the reason behind their antagonism. Just like some beneficial fungi, there are bacterial sp. like Bacillus and Pseudomonasthat degrade the wood constituents, thereby, increasing the wood porosity and permeability (Kwasnaet al.,2015).

FOREST THINNING

Another successful management strategy of Silviculture practices is 'Forest Thinning'. Parts of trees are selectively removed creating gaps, eventually increasing sunlight which improves forest microclimatic condition.Forest thinning has both positive and negative effects on microorganisms.Huge gaps between the trees leads to high temperature differences

in the soil and ambient air, exposing the bacteria and fungi to be attacked by nematodes. In an observatory study of Chinese fir plantation it was reported that soil microbial diversity increases the soil organic carbon content through decomposition of leaf litter,thus, contributing towards maintenance of fertile soil (Ran *et al*., 2019).

Pruning

Next important aspect of silvicultural system is the pruning of roots and stand (Fig.1), which inadvertently grooms individual of plant species.Root pruning of plants is a method used to adjust the sections above- and belowthe sub-surface. It improves the vegetative and reproductive growth by controlling the expanse of root system. Pruning of root stimulates the germination of a large number of fine roots from the point of incision. Root exudateincrease by the incising roots fine, thereby significantly increasing the enzymatic activity and the microbial population. It enhances the effectiveness and supply capabilities of nutrients in the soil resulting in improved soil fertility (Wang *et al*., 2017).

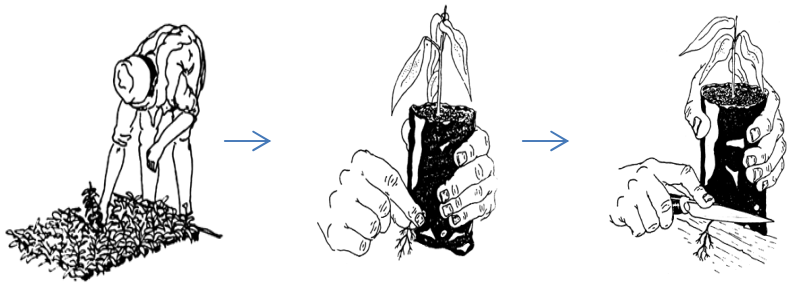

Fig:1 Root pruning of plants (Source: Wang.,2017)

Pruning and mowing crops often results in the arthropod movement from cut plant material and enhances flowering in a plant (Letournea and Altier1999). On the other hand stand pruning of trees is the practice which is performed in an appropriate manner to control shoot height. It is basically performed to get uniform crop size, better fruit-bud differentiation and faster wound healing with ultra violet light (Hossain*et al*.,2004).In the case of Pennsylvania's wildlife; pruning of fruit trees, provided food to many animals like white-tailed deer which fed on apples and black bear. Fallen fruit decayed on the ground andcreated a favourable environment for earthworms and birds like woodcock (Margaret and Brittingham2016).

Trimming and pruning enhances flowering and vegetative capacity of plants. For example,a pruned apical bud removes apical dominance and reduces competition for nutrients in other parts of plants. This may result in development of shoots from a large number of axillary buds. Trimming and Pruning also helps to revert woody plant parts into its juvenile form resulting in increased proportion of young leaves on the pruned rather than on the un-pruned shoots (table 1). It alsoaffects the gall inducing insect population not only by modifying the plant architecture, but also by changing the timing of plant resource availability (Martinez and Wool 2003).

Winter pruning of flowering shoots by pruning a few of old branches is called artificial extinction. This methodincreases the leaf area of shoots and light

interception through the tree canopy by decreasing the shoot density. Additionally, itimproves the physiological autonomy of the flowering shoot, mostly during the period preceding June. Furthermore, it enhances the carbon assimilation in fruits and flowers.Cutting the heads of treesinduces the formation of reiterated complexes, which recommence the structural vegetative framework of the tree. In this way, enhancing the shoot type and leaf area distribution of the tree (Stephan *et al*.,2007).

On the other hand, the nests of songbird that are tiny and camouflagedmight get destroyed due to tree trimming. Therefore, it is advised to prune trees in winter around their dormancy.

Table 1: Length of long vegetative shoots (LVS) on non-pruned and pruned ***Malusdomestica*** (Apple tree) (Stephan *et al*., 2007).

Tree manipulation	N	Vegetative shoot length (cm)
L- trees pruned shoots	9	19.59
L- trees non-pruned shoots	9	16.87

Where, N= number of shoots in a tree

Summer pruning has been used as a way to manage ripening in fruit trees. This has proven to be a very effective method of controlling the growth of the tree, increasing its flowering, and enhancing the colour of the fruit for economic benefit. Not only this, this method is also effective in enhancing the soluble solids concentration and flower bud formation while decreasing titratable acid content.On the downside, summer pruning reduces cold hardiness of buds, carbohydrate levels, fruit size and promotes trunk enlargement and potentially removes 35% to 45% of the total tree leaf area. The significant loss of leaf area on summer-pruned Peach tree may lead to a reduction in the carbohydrate and nutrient element concentrations in tissues and thus limit the growth of trees. It was reported in previous pruning studies that summer pruning on apple, almond, peach, and apricot trees decreases yield efficiency compared to winter pruning (Martinez and Wool 2003). South (1998) studied the water-saving property of pruning while focusing on the intensity of pruning in trees. It was found that the severe pruning of *Grevillearobusta* significantly reduces water demand by narrowing its xylem vessels thus also reducing its hydraulic conductivity and transpiration rate. It improves canopy translucency and adjust the relative proportions of fruit-bearing branches and vegetative shoots. Excessive pruning damages the habitat of wild animals and birds, causes floods and fire; and reduces the filtration rate of CO_2 emitted from anthropogenic activities (Rasmussen *et at*,, 2010).

Table 2 : Effect of intensity of pruning on height of plant, shoots and length of lateral branches *(Jin et al., 2018).*

Pruning intensity	Plant height	Number of main shoots	Total length of lateral branch
Severe pruning	~160 cm	1	125–175 cm
Regular pruning	~220 cm	3–4	575–625 cm

Above table represents that severe pruning delays the growth of plant as well as their shoot size and number of branches than the regular pruning.

Top pruning of trees is another drastic process that removes most of the branches down to the trunk. It is commonly used to train young trees to grow healthy (Jin et al., 2018). In a survey of Pacific Northwest nurseries, 90-92% of Bare root pine and Douglas-fir were top pruned to produce plants of a more uniform size and for uniform distribution of sunlight (fig 2) (Demirtas*et al*.,2010). Total number of buds per tree in citrus fruit plantation in Punjab were recorded higher in lightly pruned (8 feet from ground level) vigorous trees, throughout the growth period, where as the minimum were found in un-pruned trees. The highest percentage of increase in availability of buds was in the month of March (1138.50%) followed by April (184.39%), July (53.43%), May (36.62%), June (36.55%), and minimum (22.88%) was recorded in the month of August (Dhaliwal *et al*., 2014).

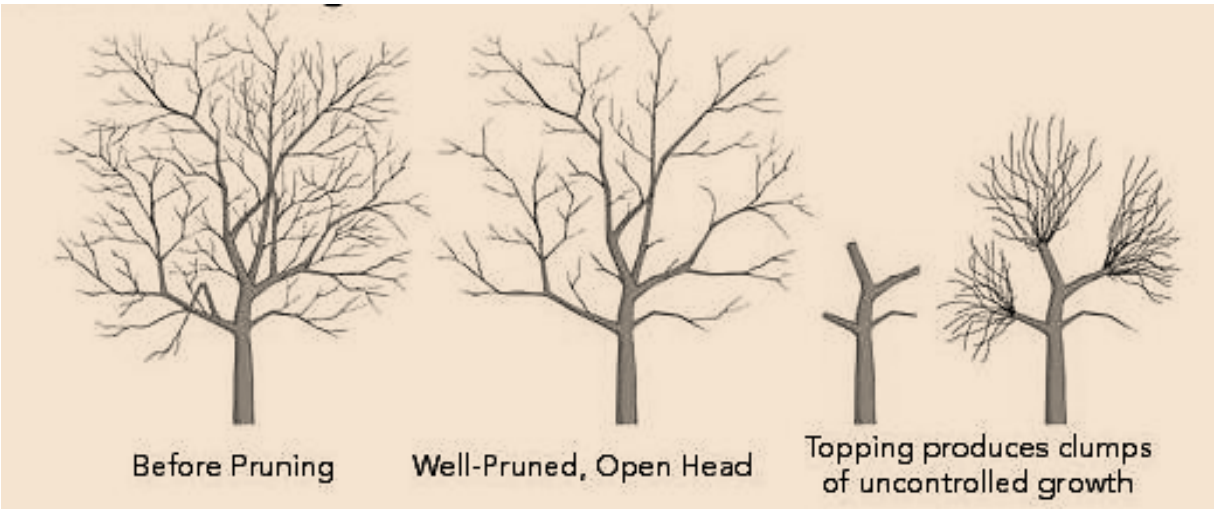

Fig: 2 Effects of pruning on trees (Source: Top Pruning By Thomas D. Landis)

Silvicutural practises and its impacts

Silviculture refers to practices that are used to manage the growth and composition of forest vegetation for an array of objectives, such as wildlife habitat, timber, water resources, recreation, and much more. Many silvicultural practices are potentially valuable tools for helping forests respond to a changing climate. Climate changes will modify the environment and cause disturbances affecting forest communities. If these modifications override the adaptive capacity of the forest ecosystem,

these forests and the goods and services they provide are vulnerable. Silvicultural practices play a crucial role in forest management and conserving forest biodiversity.

Density management promotes resistant and resilient forest communities improve adaptive characteristics that permit a plant to survive and function when subjected to water deficits, temperature extremes or uncharacteristic disturbance. Pruning is also a very effective tool of silviculture which includes root pruning and stand pruning or tree pruning. The removal of lateral roots through root pruning in closed-canopy poplar induces the germination of new roots and promotes the absorption of nutrients by the root system to enhance the growth of economically important trees. On the other hand, trees contribute to their environment by providing oxygen, improving air quality, climate amelioration, conserving water, preserving soil, and supporting wildlife.

Pruning of trees has been used in horticulture to increase the yield, improve the quality of crops and fruits. A pruned tree is capable of creating better environment for animals and other plants and improves wildlife habitat and ecology of forests. This review article was on effects of pruning of trees and plants on wildlife habitat and ecology, improving the quality of tree automatically improves the yield and significantly contributes to the ecology and environment. Pruning in winter season was more preferred than in summer as it removes the tree leaf area as a result carbohydrate and nutrient element concentrations in tissues were decreased and thus it limits the growth of trees.

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Role of nutrient cycling in forest ecosystems

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Abstract

Nutrient cycling, an important supporting service contributes 69–89% to total value of ecosystem services. It tracks pragmatic movement of nutrients during various biological processes between biotic and abiotic components of the ecosystem. In forest ecosystems, various factors like its composite species, climate, edaphic factors, fire, harvesting, hurricanes and other natural calamities determines the pace of nutrient cycling. There is a growing demand from policy makers and forest managers for spatial estimates on nutrient cycling at local, regional, and national scales.

Introduction

Plants need light, water, and nutrients during various stages of growth and reproduction. Nutrients are chemical elements which in plants are mostly absorbed by their roots as inorganic chemicals dissolved in water. Non-mineral elements like carbon (C), hydrogen (H), oxygen (O) make up to 95% of the mass in all living organisms and these nutrients are often obtained fromwater (H_2O) and carbon dioxide (CO_2) in the air. Whereas, among the mineral elements, macronutrients are needed in large quantities to perform basic functions and their availability can limit the growth of an organism.These include the elements (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). Micronutrients including boron (B), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn)are still vital for growth and metabolismthough required in much smaller amounts than the macronutrients.

Nutrient cycle is dominant ecosystem functioncontributing 69–89% to total value of ecosystem services (Zhao et al., 2004). It is an important supporting service for ecosystem which involves the pragmatic movement of nutrients between physical environment and living organism. It also tracks nutrient usage during various biological processes and the path undertaken by them to recycle back into the environment. As an essential process of an ecosystem, it is involved in exchange of organic and inorganic matter required for growth and decomposition of the living matter. It includes all the biological, geological, environmental and chemical processes and interactions and is also known as biogeochemical cycle.

The role of each nutrient in the cycle is peculiar and depends on anorganism's biological competence, its environment, geology,chemical processes and reactions. Plants and other autotrophs absorb nutrients from soil and water to make their own food using major nutrients such as carbon, hydrogen, and oxygen. Other nutrients needed by plants are nitrogen, phosphorous, potassium, calcium, magnesium, and sulphur.From these basic nutrients, plants and other autotrophs

synthesize, or create, their own nutrients, such as sugars. Other organisms mostly need nutrients created by autotrophs.

Nutrient cycling in forests

In forests ecosystems, nutrient cycling is controlled primarily by four key factors: climatic, edaphic, biotic and abiotic. Whereas, animals, plants, fungi and bacteria living above- and below-ground are some of the active and visible players, mineral components of soil, dead leaves and wood, topography, parent material of the soil, even the climatic factors like sunlight, temperature, water from rain and snowfall decides the pace and fate of nutrient cycle.

During its growth, plant absorbs mineral and non-mineral nutrients from the soilthrough its roots. While some of the accumulated nutrients are returned back to soil in the form of withered branches and leaves, rest are conserved as the net-maintained amount in form of stems and roots. Some nutrients also enter the food chain when transferred from plants to herbivore and there forth but are ultimately transported to soil after the death of plants and animals. Also, different saprophytes likearthropods and earthworms aids in decay and mixing of the decayed material with soil while fungi and other microorganisms breaks down complex compounds returning it back to the atmosphere (Foster and Bhatti, 2006; Keehn, 2017).

Factors determining pace of nutrient cycling in forests

Effect of climate on nutrient cycle

Climatic factors play major role in determining terrestrial primary productivity and availability of nutrients in different types of forests. As reported by Foster and Bhatti (2006), above ground biomass in boreal<temperate<tropical forests. Although, contrasting trend was observed for forest floor nutrients and residence time, which was seen toincrease from tropical to boreal forests. Similarly, nutrient cycling rates are low in subarctic woodland soils and Alaskan taiga forests because ofextreme environmental conditions. This can be attributed to the fact that lower altitudes have lower primary productivity and nutrient cycling rates because of permafrost, short growing season, lower soil temperatures and microbial activity whichslows rate of litter decomposition and nutrient availability increasing carbon accumulation in the soil(Van et al., 1991). Except in situations with periodic flooding, incidences of fire, soil erosion/ leaching and low litter quality, highly productive tropical forests are alternatingly catered with higher microbial activity throughout the year, resulting in faster decomposition and low carbon storage and higher litter production (Vitousek et al., 1986).

Effect of composite species on nutrient cycle

The composite species of a forest or ecosystem differs significantly in their inherent nutrient requirements and usage (Cole et al., 1981). Nutrient cycling is affected substantially by the species of a forest ecosystem thereby differing in accumulation of nutrients in the living and that disposed as the dead phytomass. Besides that, it is also strongly influenced by the quantity and quality of litter produced in a forest.Trees may obtain organic nitrogen and phosphorous from the soil mycorrhizae or by relocation from older foliage prior to abscission therebypartly reducing their dependence on soil as a source of inorganic nutrients. Litterfall from above-ground vegetation increases from boreal regions to the tropics

following the gradient of productivity. As in many temperate and boreal forest ecosystems, microbial requirement for nitrogen increases or decreases with labile supplies of soil organic carbon. It has been reported that the increased nitrogen demand by microbes may temporarily decrease its availability to trees during the initial decomposition of forest residues with a wide C/N ratio. The rate of immobilization of nitrogen by the microbes from surrounding soil is relatively rapid for readily decomposable organic matter (needle litter) and slower for recalcitrant material (branches, boles). In temperate and tropical forests, net nitrogen mineralization rates are higher and retention of foliar nitrogen is lower as compared to that in boreal forest soils. Nitrogen limitation of productivity, therefore, is weak in tropical forests and increases from temperate to boreal and tundra forest systems.

Effect of edaphic factors on nutrient cycle

Differences in the elemental content of parent material also influence the tree species composition between and within a landscape unit. Heterogeneity within the landscape results in sites differing in microclimatic conditions, and physical and chemical properties, which produces different geochemical reaction rates and pools of available nutrients in soil. Soil type and topographicmicroclimate interactions are also important feedbacks that influence biological processes. The rate of nitrogen mineralization in the soil and low phosphorous availability is a characteristic of geomorphically old, highly weathered tropical, subtropical, and warm temperate soils (Vitousek, 1986). Alternatingly, soils in glaciated regions are relatively young and rich in weatherable minerals. Type and age of parent material from which the soil is derived influences its base status and nutrient levels. Mineral weathering is an important source of most nutrients for plant uptake, with the exception of nitrogen. But nutrient availability is regulated by the balance between weathering of soil minerals and precipitation, adsorption, and fixation reactions in soil. Edaphic conditions can exert a strong influence on forest productivity and produce considerable variation in nutrient cycling processes. Soils with low N, P, or pH support trees with low litter quality (high in lignin and tannins that bind N) that decomposes slowly. Edaphic limitations may be compensated for by an increase in rooting density and depth. Some late-succession or tolerant species have a shallower root distribution relative to intolerant pioneer species and are adapted to sites where nutrients and moisture are concentrated at the soil surface. In contrast, nutrient uptake from sub-soil horizons is more important in highly weathered warm temperate soils where nutrient depletion takes place deeper in the soil.

Effect of various other factors on nutrient cycle

Natural or man induced disturbances such as fire, harvesting, hurricanes, or pests have long lingering effects on nutrient cycling. Intensive wildfires in forests results in horizontal and vertical redistribution of ecosystem nutrients which are induced either due to oxidation and volatilization of living and decomposing plant material, convection of ash particles in fire generated winds, water erosion of surface soils and percolation of solutes through and out of the soil. The relative importance of these processes varies with each nutrient and is modified

by differences in fire intensity, soil characteristics, topography, and climatic patterns. Expressed as a percentage of the amount present in vegetation and litter before fire, the changes often follow the order with, N > K > Mg > Ca > P. Activities like harvesting removes nutrients from the site and interrupts nutrient cycling temporarily. The recovery of the nutrient cycle from harvest disturbance is dependent partly on the rate of re-establishment of trees and competing vegetation. Whereas, re-vegetation may occur within months in the tropics, it takes as long as 2–5 years in temperate regions, and longer in boreal and tundra regions (Keenan and Kimmins, 1993).

The loss of nutrients is then followed by the process of recovery which assumes that the soils ability to supply nutrients to plant roots has not been altered by disturbance. If nutrients cannot be supplied by the soil at rates sufficient to at least maintain the rate of growth of the previous forest then fertilizer application may be necessary to maintain site productivity which is not practical in case of natural forests and hence there is reported change in canopy density, land use pattern and deterioration of forests. As the availability of nutrients like nitrogen, Phosphorous and potassium in soil largely determines the leaf area, photosynthetic rate, and net primary production of forest ecosystems. Forest management practices that produce physical and chemical changes in the soil that accentuate the cycle of nutrients between soil and trees, may increase forest productivity. Clear-cut harvesting and site preparation practices (mechanical disturbance, slash burning) remove nutrients from soil in tree components and by increased surface runoff, soil erosion, and off-site movement of nutrients in dissolved form or in sediment transport. In the tropics, potential negative impacts associated with clear felling and slash burning are greatest because a larger proportion of site nutrients are contained in the living biomass. Environmental impacts associated with such practices and forest management in general, are confounded by climatic, topographic, soil, and vegetation diversity associated with the forests. Best forest management practices can be utilized to control negative impacts on nutrient cycling (Foster and Bhatti, 2006).

Valuating nutrient cycling

Nutrient cyclingis one of the most significant supporting service for forest ecosystem. There have been limited evidences of any studies and set methodology for estimation of it in India. Literature survey revealed that various authors used different methods like Bait lamina (Von Torne, 1990;Kratz 1998; André et al., 2009; Rożen et al.,2010), Litter bag method (Crossley & Hoglund, 1962; OECD, 2006; Villanyi et al., 2008), Mini container method (Knacker et al.,2003), Near-infrared reflectance spectroscopy (NIRS) (Du & Zhou 2009, Reeves 2010), Stable isotope methods (Sharkovand Lodko, 1977; Tiunov 2007; Hyodo et al. 2010). But all these methods majorly focussed on estimations of organic matter.

Although it is not feasible to directly estimate benefits derived from these services in monetary terms but various indirect methods used to quantify this ecosystem function. Alternative cost method is considered effective method and is been used in estimation nutrient cycling in ecosystem services (Adger *et al* 1995;Costanza, *et al*., 1997; SEPA, 1998; Xue and Tisdell, 2001)

Conclusion

It can be concluded that nutrient cycling majorly helps in transformation of matter from one form to another to enable absorption and utilisation in different organisms, it aids in storage and transfer of elements from one location to another. It links biotic with the abiotic elements and vice versa and are responsible for functioning of ecosystems. The wellbeing and stability of any ecosystem and its organisms is highly dependent on its dynamic yet balanced nutrient cycle and hence it acts as valuable part of ecosystem services.

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Mahogany shoots borer, *Hypsipyla robusta* and its control measures

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Abstract

This article deals with the pest profile of *Hypsipyla robusta* Moore (Lepidoptera: Pyralidae), a potential shoot borer of mahogany, *Swietenia macrophylla* King and *S. mahagony* (L.) Jacq. (family Meliaceaee) in seedling stage and young plantation. The management aspect of this insect pest is mentioned.

Key words: Mahogany, *Swietenia macrophylla*, *Swietenia mahagony*, shoot borer, *Hypsipyla robusta*, control measures

Introduction

Swietenia species (family Meliaceae), commonly known as 'mahogany', are native to tropical America (CABI, 2005). Three species are recognized. The most well-known and widely planted is *Swietenia macrophylla* King, commonly called 'big-leaved' or 'broad-leaved' mahogany, to distinguish it from the small-leaved *S. mahagony* (L.) Jacq (Fig. 1). The natural distribution of *S. macrophylla* covers south-east Mexico in North America; Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama in Central America; and Bolivia, Brazil, Colombia, Ecuador, Peru and Venezuela in South America. *S. mahogany* is common in the Caribbean countries (Nair, 2007). These evergreen trees grow up to 30–45 m tall. The third species, *S. humilis* Zucc., is a smaller tree, 8–10 m in height, and commonly distributed in Central America. The biological boundaries between the three species are

Fig. 1: Mahagoni tree, *Swietenia mahagoni* (source: https://en.wikipedia.org/wiki/Swietenia_mahagoni#/media/File:Tree_in_new_leaves_I_IMG_6222.jpg

not clear-cut and natural hybrids occur (CABI, 2005). *S. macrophylla* is the most widely distributed and the most widely planted of the trees, both in native and exotic locations. It is moderately fast-growing and is usually grown in a 30–40 year rotation. It produces one of the

world's best furniture timbers. *S. mahagony* is also raised in plantations, but to a much lesser extent. Plantations of *S. macrophylla* have been raised in over 40 countries outside its native range, throughout the lowland humid and sub-humid tropics in South and Southeast Asia, the Pacific Islands, the Caribbean and tropical Africa (CABI, 2005). In 1995, the plantations covered 151 000 ha worldwide (Pandey, 1997). Indonesia has about 55 000 ha (Cossalter and Nair, 2000) and Fiji has 26 500 ha (Kamath et al., 1996).

Overview of insect pests

Browne (1968) has mentioned 21 insect species belonging to the order-Coleoptera (10 species), Hemiptera (1 species), Isoptera (2 species), Lepidoptera (7 species) and Orthoptera (1 species) associated with *S. macrophylla*, whereas 8 insect species belonging to the order-Coleoptera (2 species), Hemiptera (1 species) and Lepidoptera (5 species) associated with *S. mahagoni*. However, in exotic plantations of mahogany, the dominant pest is a shoot borer, *Hypsipyla robusta*, which is common to both *S. macrophylla* and *S. mahagoni*. The pest profile and control measures of this shoot borer are summarized below.

***Hypsipyla robusta* Moore (Lepidoptera: Pyralidae)**

Hypsipyla robusta (syn. *Hypsipyla pagodella*) is commonly known as mahogany shoot borer. This insect is widely distributed in the old world tropics and extending into the subtropics, in the Commonwealth recorded in India, Burma, Sri Lanka, Pakistan, Malaysia and Nigeria, and also present in most of the other African and oriental territories (Browne, 1968). Each female lays several hundred white eggs on leaves, young shoots or other succulent parts of the host. The larva attains a fully grown length of about 30 mm and is of variable colour with longitudinal rows of black and setiferous spots. One larva may infest more than one shoot during the course of its development. The larva is principally destructive as a shoot borer, but also attacks inflorescences and fruits (Beeson, 1941). Pupation occurs in a cocoon, either within the larval tunnel or in other sheltered places on the host, The moth is rufous-brown mixed with grey and black, forewing with veins streaked with black and crossed with zigzag black lines and patches, hindwing whitish, semi-hyaline, the margin and costal zone darker, wing expanse 26-32 mm in male and 28-42 in female (Fig. 2). In India, the length of the life cycle varies from about 1-6 months according to season. The species usually undergo overwintering as a fourth instar larva.

Fig. 2: Adult moth of mahogany shoot borer, *Hypsipyla robusta*

Regarding the host plants of *H. robusta*, 21 species have been reported, such as *Canarium schueinfurthii*, *Carapa guianensis*, *Cedrela australis*, *C. mexicana*, *C. multijuga*, *C. odorata*, *C.sureni*, *C. toona*, *Chukrasia tabularis*, *C. velutina*, *Entandrophragma angolense*,

E. utile, *Khaya anthotheca*, *K. ivorensis*, *Soymida febrifuga*, *Swietenia candollei*, *S. macrophylla*, *S. mahagoni*, *Toona ciliate*, *Xylocarpus guianensis* and *X. moluccensis* (Fletcher, 1914; Beeson, 1919; Ardikoesoema and Dilmy, 1956; Brunck and Fabre, 1974; Ramaseshiah and Sankaran, 1994).

H. robusta caterpillars bore into the tips and shoots of several species of high quality timber species. In India, it is a particular pest of mahogany and is capable of causing 100 percent mortality of seedlings and young plantations. The caterpillars destroy the apical shoot causing the tree to form many side branches and frequently a deformed trunk leading to a decreased value of the timber. This insect can destroy plantations.

Control measures

Resistant clones/provenances need to be exploited as an element for integrated management of mahogany shoot borer (Cornelius and Watt, 2003; Wightman et al., 2008). According to Mishra (1993), the entomogenous fungus, *Beauveria bassiana* is a promising pathogen for the biocontrol of this serious shoot borer infesting *S. macrophylla* in India. Joshi and Jamaluddin (2007) have recommended pruning of attacked shoots in young plantations and regular thinning of young attacked trees. Mohanadas (2000) has suggested spraying of 0.5% Dimethoate (Rogor 30 EC) or 0.1% Phosphamidon (Dimecron 85 SL) for 100% mortality of mahogany shoot borer.

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