ANTIFUNGAL ACTIVITY OF PLANT EXTRACT AGAINST *ALTERNARIA ALTERNATA* THE CAUSAL AGENT OF LEAF SPOT DISEASE OF *ANDROGRAPHIS PANICULATA* WALL. EX. NEES.

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INTRODUCTION

Medicinal plants traditionally occupied an important position in the lives of rural and tribal of India and are considered as one of the most important sources of medicines since the dawn of human civilization. Medicinal plants constitute the basis of primary health care for the majority of the population in India and are an important source of income for rural population. Approximately 90% of these plants are still collected from the forests. The primary aim of the present study was to identify fungal diseases and pathogens associated with the medicinal plant Kalmegh. (Table-1) and to evolve methods of management of diseases.

Andrographis paniculata

(Kalmegh*)* is a bitter annual (perennial, if maintained) herb, erect, 50 cm to 1m. in height, stem quadrangular, much branched; leaves opposite, short petioled; flowers creamy yellow in racemes. Fruit capsule linear, oblong or elliptic; seeds about 12 in number, subquadrate, It is widely distributed throughout plains of India from Uttar Pradesh to Assam, Madhya Pradesh, Tamil Nadu and Kerala. It is a herbaceous plant of family *Acanthaceae*, native to India and Sri Lanka. It is widely cultivated in Southern and Southeastern Asia, where it is used for treating various diseases, often used before antibiotics were created. Mostly the leaves and roots were used for medicinal purposes. Kalmegh is used in flu, upper respiratory tract infection, cough and bronchitis. Kalmegh plant acts as anti-typhoid. It Kalmegh has a great reputation in the Tribal folklore, as one of the best remedies for Malaria, is a blood purifier, so used to cure jaundice, dermatological diseases, dyspepsia, febrifuge and anthelmintic, acts to dispel heat and remove toxins acts as antibacterial. It appears to have beneficial effect in reducing diarrhoea and symptoms arising from bacterial infections.

MATERIAL AND METHODS

Collection, Isolation and Identification of causal organisms- Diseased specimens and soil samples collected from the nurseries of SFRI, TFRI & JNKVV and some cultivated fields of Jabalpur district field collected samples were transported in a polybags to the laboratory and isolation of pathogens was done in a desired media without any delay to avoid saprophytic contamination. The symptoms caused by the micro-organisms were carefully examined at the collection spots. The specimens collected in separate polythene bags and locality, date of collection, habitat, external features if any colour of spots and extent of damage caused to a particular part of the plant was recorded in field diary. From a aerial fructification of developing fungus which are visible, picked few spores with the help of a sterile inoculating needle and transferred it to the culture media. By doing this, pure culture was obtained from the first transfer itself. Since molds grow rarely free from other organisms, contaminants are often transferred with the fungus under these conditions. Under these circumstances, the cultures by means of pure culture were purified techniques.

Tissues from the diseased portion of the plant were cut into 1 mm piece with the help of sterilized blade and forceps were surface sterilized for 5 min. in solution of sodium hypochloride in sterile water (aseptic condition). These were transferred into the Petridishes containing pre sterilized PDA medium supplemented with rose-bengol and stretopenicillin (Agarwal & Hasija,1986).The Petridishes were incubated at 28 ± 2^0c temp in a low temperature incubator, examined regularly and as soon as growth appeared it was transferred into slants containing PDA medium. Isolation of micro organisms from infected specimens was also done following pour plate and blotter methods. The colonies visible at the surface of the diseased parts were also directly transferred to PDA slants. These were brought to single spore culture with the help of dummy cutter objective. Cultures were maintained in PDA slants.

The identification and further confirmation of fungi was done by preparing slides of the fungal growth and observing them through binocular microscope. The identification was done with the help of available literature. Pure cultures of these fungi were prepared and maintained on potato dextrose agar (PDA) slants.

RESULT AND DISCUSSION

Studies on diseases of aromatic and medicinal plants were conducted in nurseries of SFRI, TFRI & JNKVV and some cultivated fields of Jabalpur district. A systematic and periodical survey of various localities was done and infected parts of the plants collected for pathological examination. Disease in kalmegh plants was observed during the summer and rainy season in SFRI and JNKVV nurseries, the plant was affected by the leaf spot disease, pathogens were collected from diseased plants, cultured on PDA medium and incubated at 28 ± 2^0c. After seven days, colonies were formed on the surface of PDA plates usually black, sometimes grey. Conidiophores in small groups, being branched, straight golden brown and smooth. Based on morphological features, the fungus was identified as *Alternaria alternata* Disease is appear in summer and rainy season.

The effect of various plant extracts on the leaf spot disease is summarized in Table 1

Table-1 Effect of various plant extracts on the growth of *Alternaria alternata* in *in-vitro* at various concentrations (Management of leaf spot disease in Kalmegh)

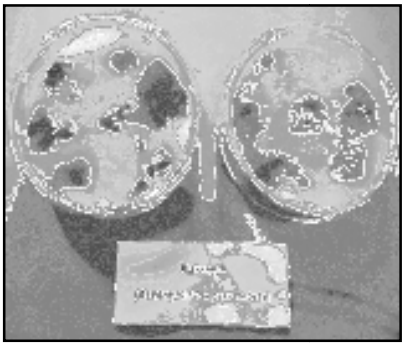
Name of plant extract used	Various concentrations					
	5% conc.		10%conc.		15% conc.	
	Av. Colony diameter (mm)	Growth inhibition (%)	Av. Colony diameter (mm)	Growth inhibition (%)	Av. Colony diameter (mm)	Growth inhibition (%)
Woodfordia fruiticosa	64.63	18.90	58.25	28.08	51.10	36.71
Boswellia serrata	61.21	23.20	42.25	47.84	46.25	42.72
Ocimum americanum	65.75	17.50	53.14	34.39	49.60	38.57
Vitex negando	70.15	11.98	63.19	21.98	52.68	34.76
Azadirecta indica	75.65	5.08	65.70	18.88	54.25	32.81
Control	79.70	-	81.00	-	80.75	-

The extract of *Boswellia serrata*, *Ocimum americanum and Woodfordia fruiticosa* with three concentrations viz. 5 %, 10% and 15 % were evaluate *in- vitro* by poisoned food technique for their efficacy against *Alternaria alternata*. The results presented in the table-4 indicated that the different plant extracts have varied efficacy at all the three concentrations tried. The extracts of Boswellia leaves were inhibitory to the mycelial growth of even at 5 percent concentration tried as compared to the control. It was effecting in checking the fungal growth 23.20 %, 47.84 % and 42.72 % over the other plant extracts at 5 percent, 10 percent and 15 percent concentrations respectively. Extract of *Woodfordia fruiticosa* (Dhawai) leaves was second best at 5 percent concentration in checking the fungal growth (18.90 %). Next best in order of merit after *Boswellia serrata* at 10 percent and 15 percent was extract of *Ocimum americanum* (34.39%and 38.57%). Extract of *vitex neguando* and *Azadirecta indica* exhibited slight inhibitory effect at all the three concentrations tried with respect to the other extracts. Results indicated that the extracts of *Boswellia serrata* leaves gave maximum inhibition followed by extract of *Ocimum americanum and Woodfordia fruiticosa* while extract of *Vitex negando* and *Azadirecta indica* were ineffective at 5 percent and 10 percent concentrations.

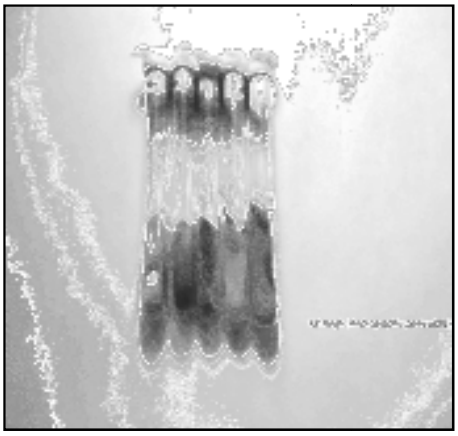
CHEMICAL CONTROL

Foliar spraying of Bavistin (0.2%) at 10-15 days intervals on Kalmegh plants in initial stage of disease was found effective. From this study it is concluded that the diseases of Kalmegh plants can be managed by application of plant extracts of plants.

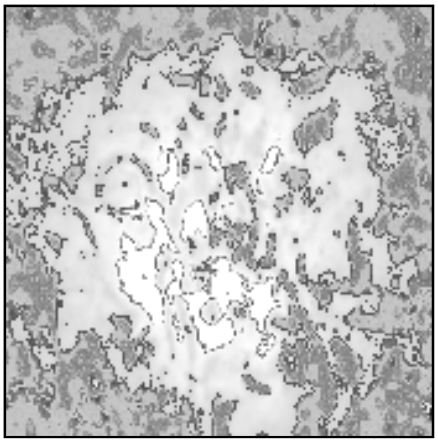
Diseased plant of Kalmegh



Culture of pathogen



Pure culture of pathogen



Spores of Alternaria *alternata*

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PLANT DIVERSITY IN DINDORI DISTRICT OF MADHYA PRADESH

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ABSTRACT

In the present paper a plant diversity of 1104 species of Angiosperms (653 genera belonging to 144 families), 24 species of Pteridophytes, 11 species of Bryophytes and 41 species of Thallophyta is recorded on the bases of secondary documentation and primary surveys. The statistical composition of floral diversity is discussed in the paper in detail.

INTRODUCTION

The state of Madhya Pradesh is one of the richest states in terms of Biodiversity, be it wild or be it agro-biodiversity. The people of the state are dependent on agriculture and forests for their livelihood. It is also the second largest state and has varied climatic and edaphic factors that determine the distribution of wild resources as well as selection of crops for farming. Its tribal population, which is dependent on various forest resources for their subsistence as well as sustenance, plays an important role in conservation of forests. They use plants as food, fodder, medicine, fuel, in house building and other multifarious uses. The importance of medicinal plants is now well known worldwide and it will not be exaggeration if we call the present era, the era of herbal products. The use of herbs is increasing day by day not only in medicines but also in cosmetics and as food supplements and health tonics. During the study an attempt has been made to record plant diversity exist in the district throght secondary and primary surveys.

STUDY AREA

District Dindori was carried out of Mandla district and came into existence from 25th May 1998. The holy river Narmada passes through the district. It is surrounded by the 3 districts of Madhya Pradesh (viz., Jabalpur, Mandla and Anuppur) and 2 districts of Chhatisgarh (viz., Bilaspur & Kawardha). It has 2 subdivions, 2 tehsils and 1 Zila Panchayat. It is located at 81^{0}34' degree longitude and 21^{0}16' degree latitude. It is situated at an elevation of 1100 m above sea level amongst herbal-rich, Maikal mountain ranges.

The newly formed district has geographical area as 571883 hec. Out of which forest cover is 213418 hec. (37.32%) and agriculture area 238383 hec. (41.68%). There are 2 tehsils, 7 development blocks, 349 gram panchayats and 2 Nagar Panchayats/ Towns. Total number of villages is 926 (841 revenue villages and 85 forest villages) with 2347 of habitations in 102 clusters. The region was ruled by the Lodhi & Gond dynasties at the time when Gond dynasty ruled, the region named as Gondwana. Rani Awanti Bai, queen of Ramgarh belonged to Lodhi dynasty and Hradayshah, Sangramshah and Rani Durgawati of Gondwana dynasty are some of the well known names of that time. Historic monuments like Temple of Kukarramath, Kisalpuri & Mudiakhurd have historic importance.

Dindori has rich and varied biodiversity due to its diversified topography and variable climatic conditions. However, no documents are available on biodiversity of Dindori district; only scattered literature is available on the subject. Madhya Pradesh State Biodiversity Board, Bhopal assigned the task to SFRI to document the biodiversity of Dindori district on primary and secondary data basis.

The forest area is generally covered by Deccan trap basalts which are underlain by Gondwana system of rocks. Intertrappean beds (Lametas) are found between two trap flows. The intertrappeans are rich in plant and mollusc fossils at places like Ghughwa, Barbaspur etc. Bauxite is also found on top of the hills near Amarkantak. In the south eastern part of the district (South Samnapur Range), some Archean rocks have also been found. The soil derived from the aforesaid rocks is varied. Latertic murrum is the most common soil found on plateaus as well as in valleys. Lower areas bear black cotton soil. The density and quality of forests is largely dependant upon Geology and water bearing capacity of the soil.

The climate of the tract is tropical monsoonic having well defined summer, winter and rainy seasons. The area mainly, receives rainfall from south-west monsoon and in winters from north-east monsoon. The average annual rainfall is nearly 1417.90 mm. During summer the average highest temperature varies from 33.1 to 40.80°C while during winters, average lowest temperature ranges from 8.2 to 11.40°C.

The Dindori forests are largely found on the Maikal hills south of Narmada river, part of Mehendwani plateau and on Shahpura plateau north of Narmada river. It relects a mixture of hills, hillocks and plains. Slope is

generally gentle to moderate. The higher reaches of the hills are flat-topped and are locally called "Dadars". The highest point, namely Nanhudadar (Pakri-Sondha), is 1115.6 mtrs. above M.S.L. The forests of the area, classified on the basis of system developed by Champion & Seth (1964) are :-

1. Moist Peninsular Sal Forest 3C/C_2e
   (i) Moist Peninsular High Level Sal Forests 3C/ C_2e (i)
   (ii) Moist Peninsular Low Level Sal Forests 3C/ C_2e (ii)
   (iii) Moist Peninsular Valley Sal Forests 3C/ C_2e (iii)
2. Southern Dry Mixed Deciduous Forest 5A/C_3

Sal (S*horea robusta)* is dominant trees species in the region with varying associates at different places. Species like *Terminalia tomentosa, Emblica officinalis, Terminalia chebula, Buchanania lanzan, Schliechera oleosa, Madhuca latifolia, Terminalia bellerica, Terminalia arjuna* etc. are found with Sal as dominant tree species. Whereas species like *Bauhinia variegata, Mallotus philippinensis, Cassia fistula, Ougenia oojeinensis, Woodfordia fruticosa, Indigofera pulchella, Hateropogon contortus, Bauhinia vahlii, Smilax zeylanica, Lantana camara, Cassia tora* etc. are also associated as under wood.

Methodology

During this study, information on plant diversity in Dindori district was gathered from the review of secondary information, past works and primary field surveys in various forest ranges of the district. An inventory of collected plant specimens was prepared. All the collected and inventoried specimens were identified with the help of published Floras. The specimens were arranged in their respective families following the Bentham and Hooker's system of classification (1862-1883).

Results & Discussion

Plant diversity

A list of plant diversity of 1180 species is prepared. Out of which 1104 species of Angiosperms (653 genera belonging to 144 families), 24 species of Pteridophytes, 11 species of Bryophytes and 41 species of Thallophyta is catalouged on the bases of secondary documentation and primary surveys.

During the study, an inventory of 1104 plant species of Angiospermic group, 206 species of trees, 132 species of shrubs, 475 species of herbs, 115 species of climbers, 172 species of grasses and 2-2 species of parasites and epiphytic plants species is recorded. It is also observed that Dindori is rich in herbaceous species compared with other adjoining districts**.**

Table – 1: Number of plant species under different habits

S.No.	Habit	No. of Species	Percent
1	Climber	115	10.42
2	Epiphytic plants	2	0.18
3	Grass	172	15.58
4	Herb	475	43.03
5	Parasitic plants	2	0.18
6	Shrub	102	9.24
7	Tree	206	16.03
8	Under Shrub	30	2.72
		1104	

Among the total 142 families recorded from the study area, 51 families represent only one species; 18 families are having two species. 8 families have three species; 16 families have 4 species, 4 families have 5 species 2 families having 6 species, 7 families having 7 species, 4 families having 8 species, 1 families having 10 species,4 families having 12 species, 1 families having 14 species, 2 families having 11,13,16,17,19,33 and 37 species. Families namely, Convolvulaceae, Malvaceae, Apocynaceae, Rubiaceae, Asteraceae, Mimosaceae, Fabaceae and Poaceae are having 7, 12, 13, 15, 16, 17, 31 and 37 species, respectively, whereas Asclepiadaceae, Lamiaceae and Solanaceae are having 8 species. Poaceae is the most dominant family and holds the first position with 128 species. Fabaceae scored second position with 77 speceis. Asteraceae stands third with 71 species and Cyparaceae hold fourth position with 37 species . 51 families were identified with only one species

Table : 2: Ten dominant families

S.No.	Family	No. of Species
1.	Poaceae	128
2.	Fabaceae	77
3.	Asteraceae	71
4.	Cyperaceae	37
5.	Verbenaceae	36
6.	Acanthaceae	34
7.	Euphorbiaceae, Rubiaceae	33
8.	Malavaceae	27
9.	Caesalpiniaceae	24
10.	Scrophulariaceae	23

The percentage of species of dicotyledons and monocotyledons found in the flora of Dindori district is 74.17 and 25.82 respectively, while in the flora of the world, it is 81.30 and 18.70 respectively. Thus, the percentage of monocotyledons in the flora of Dindori area is very high.

Table : 3: Families, Genera and Species belonging to Dicots and Monocots

Group	Families	Genera	Species
Dicots	12	113	237
Monocots	130	509	867
Total	**142**	**622**	**1104**

Non Timber Forest Produce

Non-Timber Forest Products (NTFPs) in remote tribal dominated and forest areas play an important role in their socio-economic system and meeting day to day needs of livelihood. At least 60% of available NTFPs are directly consumed for self sustenance, whereas, 40% are sold. Thus, making influential impact on household economy. These products ultimately reach various industries (from local to national level) through retailers after inflow in various steps in market channel.

Table – 4: List of NTFPs available in the region

S.No.	Botanical Name	Family	Local Name	Parts Used
1.	*Acorus calamus*	Araceae	Bach	Rhizomes
2.	*Aegle marmelos*	Rutacaeac	Bel	Fruits
3.	*Annona squamosa*	Annonscoac	Sitaphal	Fruits
4.	*Argemone mexicana*	Papaveraceae	Bhakrenda	Fruits/Seeds
5.	*Asparagus racemosus*	Liliaceae	Sataver	Tubers
6.	*Bauhinia purpuria*	Caesalpiniaceae	Koilarbhaji	Leaves
7.	*Bauhnia vahlii*	Caesalpiniaceae	Mahulrassi	Bark, Leaves
8.	*Bombax ceiba*	Bombacaceae	Kapsa	Seeds
9.	*Buchnania lanzon*	Anacardiaceae	Achar	Fruits/Seeds
10.	*Butea monosperma*	Fabaceae	Parsa, Tesu	Gum, Flowers
11.	*Caesalpinia bonduc*	Caesalpiniaeac	Gataran	Fruits
12.	*Carissa carandas*	Apocynaceae	Karonda	Fruits
13.	*Cassia tora*	Caesalpiniaceae	Chakora	Seeds
14.	*Celastrus paniculata*	Celastraceae	Amjun	Fruits
15.	*Chorophytum arundinacium*	Liliaceae	Safedmusli	Tubers
16.	*Clausena pentaphylla*	Rutaceae	Ratanjot	Fruits
17.	*Curculigo orchioides*	Amaryllidaceae	Kalimusli	Tubers

18.	*Curcuma angustifolia*	Zingiberaceae	Teekhur	Tubers
19.	*Cynodon plectostachyum*	Poaceae	Stargrass	Leaves
20.	*Dendrocalamus strictus*	Poaceae	Bans-kareel	Rhizomes
21.	*Dendrocalamus strictus*	Poaceae	Bans-seeds	Seeds
22.	*Dioscorea spp.*	Dioscoreaceae	Karuakanda	Tubers
23.	*Dioscorea spp.*	Dioscoreaceae	Sendukand	Tubers
24.	*Dyospyros melenoxylon*	Ebenaceae	Tendu	Fruits
25.	*Diospyros melenoxylon*	Ebenaceae	Tendu	Gum
26.	*Diospyros melenoxylon*	Ebenaceae	Tendu	Leaves
27.	*Emblica officinalis*	Euphorbiaceae	Aonla	Fruits
28.	*Emellia ribes*	Myrsinaceae	Baibedang	Fruits
29.	*Flatcortia indica*	Flacortiaceae	Kathai	Fruits
30.	*Fungi spp.*	Agarieaceae	Pehri	Fruiting-bodies
31.	*Fungi spp.*	Agarieaceae	Puttu	Fruiting-bodies
32.	*Honey*	-	Honey	Honey
33.	*Litsea glutinosa*	Lauraceae	Maida	Bark
34.	*Madhuca latifolia*	Sapotaceae	Mahua	Flowers
35.	*Madhuca latifolia*	Sapotaceae	Mahua	Fruits/Seeds
36.	*Mangifera indica*	Anacardiaceae	Aam	Fruits
37.	*Ocimum sanctum*	Lamiaceae	Van tulsa	Leaves
38.	*Pennisetum hohenackeri*	Poaceae	Moya	Leaves
39.	*Phonex acualis*	Palmaceae	Chind	Leaves
40.	*Prosopis cineraria*	Fabaceae	Khejra	Pods
41.	*Pterocarpus marsupium*	Fabaceae	Beja	Barks
42.	*Pterocarpus marsupium*	Fabaceae	Beja	Fruits
43.	*Ranidia dumetorum*	Rubiaceae	Manihar	Seeds
44.	*Ricinus communis*	Euphobiaceae	Andi	Seeds

45.	*Schleichera oleosa*	Sapindaceae	Kusum	Gum
46.	*Semicarpus anacardium*	Anacardiaceae	Bhilwa	Fruits
47.	*Shorea robusta*	Dipterocarpaceae	Sal	Gum
48.	*Shorea robusta*	Dipterocarpaceae	Sal	Seeds
49.	*Soymida febrifuga*	Meliaceae	Rohina	Fruits
50.	*Sterculia urens*	Sterculiaceae	Kullu	Gum
51.	*Syzygium cumini*	Myrtaceae	Jamun	Fruits
52.	*Tamrindus indica*	Fabaceae	Imli	Pods
53.	*Terminalia bellerica*	Combretaceae	Bahera	Fruits
54.	*Terminalia chebula*	Combretaceae	Harra	Fruits
55.	*Terminalia tomentosa*	Combretaceae	Saja	Fruits
56.	*Thysanolaena maxima*	Poaceae	Phoolbahari	Stem inflorecence
57.	To be indentifed	-	Paibela	Fruits
58.	To be indentifed	-	Guhi	Fruits
59.	*Wax*	-	Wax	Wax
60.	*Woodfordia fruticosa*	Lythraceae	Dhawaii	Flowers
61.	*Ziziphus xylopyra*	Rhamnaceae	Ghataphal	Fruits

A study of participatory involvement of tribals, forest dwellers and various ethnic-groups in collection of various NTFPs and income from their sale in the region revealed that 57% households were involved in the collection of NTFPs as an additional source of income for their livelihood.

Important Medicinal Plants

Fifty five plant species were recorded as medicinal plants in the district. Villagers collect medicinal plants from forest areas and sell them in the local markets. Some commercially important species viz. Buch, Bel, Satawar, Malkangni, Bramhi, Safed musli, Keokand, Kali musli, Van haldi, Aonla, Kalihari, Gudmar and Nirgundi are also available in the area. Medicinal plants used by different tribal groups have been documented with their uses alongwith ailments **Table – 5.**

Table – 5: Uses of Medicinal plants as per ailments

S. No.	Botanical Name	Type of Aliments
1.	*Abutilon glaucum Sw.*	Antipyretic
2.	*Achyranthes aspera L.*	Asthma
3.	*Adhatoda vasica Nees*	Antipyretic
4.	*Adiantum sp*	Emollient
5.	*Agave sisalana Perr.*	Antipyretic
6.	*Andrographis paniculata (Burm.F) Wall.*	Malarial fever
7.	*Antidesma diandrum (Roxb) Roth.*	Antidote
8.	*Aristolochia elegans Mast.*	Antipyretic
9.	*Aristolochia indica Linn*	Antiseptic
10.	*Asparagus racemosus Willd.*	Aphrodisiac
11.	*Bauhinia malabarica Roxb.*	Astringent
12.	*Bridelia retusa Spreng*	Aphrodisiac
13.	*Butea monosperma (Lam). Toub.*	Tumor
14.	*Butea superba Roxb.*	Astringent
15.	*Careya herbacea*	Antipyretic
16.	*Chlorophytum tuberosum (Roxb) Baker*	Aphrodisiac
17.	*Chloroxylon swietenia DC.*	Antiseptic
18.	*Colocasia Indica L.*	Antidote
19.	*Costus speciosus (Koen) Smith.*	Astringent
20.	*Curcuma angustifolia Roxb.*	Cooling
21.	*Curcuma caesia Roxb.*	Asthma
22.	*Daedalacanthus purpurascens T. Anders*	Leucorrhoea
23.	*Dendrocalamus strictus (Roxb.) Nees.*	Astringent
24.	*Desmodium triflorum (L.) DC.*	Astringent
25.	*Dioscorea daemona Roxb.*	Nutrient
26.	*Dioscrea bulbifera L.*	Tonic
27.	*Elephantopus scaber L.*	Astringent

28.	*Eranthemum purpuriscens Nees.*	Asthma
29.	*Eulaliopsis binata (Retz.) C.E. Hubb*	Antidote
30.	*Flemangia semialata (Roxb.) ex Ail*	Astringent
31.	*Flemingia strobilifera (L.)R. Br.*	Aphrodisiac
32.	*Gardenia latifolia Ait.*	Astringent
33.	*Gloriosa superba L.*	Abortifacient
34.	*Hemidesmus indicus (L.)R. Br.*	Antipyretic
35.	*Indigofera oblongifolia Forsk.*	Antidote
36.	*Lawsonia alba Lamk.*	Growth of hair
37.	*Loranthus longifloris Desr.*	Astringent
38.	*Mucuna pruriens (L.) DC.*	Aphrodisiac
39.	*Olax scandens Roxb.*	Anaemia
40.	*Pennisetum alopecurus (Steud.)*	Antidote
41.	*Peristrophe bicalyculata (Retz.)Nees.*	Antidote
42.	*Plumbago zeylancia Linn*	Women Sterility
43.	*Schrebera swietenioides Roxb.*	Leprosy
44.	*Shorea robusta Gaertn.*	Astringent
45.	*Sphaeranhthus indicus L.*	Antiseptic
46.	*Swertia angustifolia Buch.*	Antipyretic
47.	*Tectona grandis L.F. Suppl.*	Antiseptic
48.	*Terminalia arjuna (DC). Wight & Arn.*	Astringent
49.	*Thymus serphyllum L.*	Vermifuge
50.	*Tridax procumbens Linn.*	Astringent
51.	*Uraria lagopoids Devs.*	Astringent
52.	*Uraria picta (Jacq) Desv. ex DC.*	Antidote
53.	*Wendlandia exserta D.C.*	Astringent
54.	*Wrightia tinctoria (Roxb.) R. Br.*	Astringent
55.	*Xanthium strumarium Roxb.*	Sedative

Status of RET status of plants

Inventory of endemic, rare and threatened medicinal plants has been prepared on the basis of seasonal survey and available field information. IUCN red list category and threat assessment methods for evaluating the status of medicinal plants have been followed as per threat area. Data revealed that no endemic medicinal plant species was identified from the area. 17 vulnerable species, 5 endangered species and one near threatened species were identified from the collected data. Status of endemic, rare and threatened medicinal plants in the district has been analysed and presented in Table – 6 with names of plant species, family and threat status of the species. Data sheets of all threatened species have been prepared.

Table – 6: RET list categories of Medicinal Plants

S. No.	NAME OF SPECIES	FAMILY	THREAT STATUS
1.	*Amorphophallus paeoniofolus (Denn) Nicol*	Araceae	VU
2.	*Aristolochia bracteolate Lam.*	Aristolochiaceae	VU
3.	*Bacopa monnieri (L) Wettst.*	Scrophulariaceae	VU
4.	*Bauhinia vahlii W. & A.*	Caesalpiniaceae	NT
5.	*Centella asiatica (L) Urban.*	Apiaceae	VU
6.	*Ceropegia hirsute W. & A.*	Asclepiadaceae	EN
7.	*Clerodendrum serratum (L) Moon*	Verbenaceae	EN
8.	*Costus speciosus L.*	Zingiberaceae	VU
9.	*Curcuma zedoaria (Christ) Roscoe*	Zingiberaceae	VU
10.	*Dillenia pentagyna Roxb.*	Dilleniaceae	VU
11.	*Dioscoria bulbifera L.*	Dioscoreaceae	VU
12.	*Embelia tesjeriam-cotton*	Euphorbiaceae	VU
13.	*Equisetum ramosissimum Desf.*	Equisetaceae	EN

14.	*Gloriosa superba L.*	Liliaceae	VU
15.	*Gymnema sylvestre R.Br.*	Asclepiadaceae	VU
16.	*Litsea glutinosa (Lour) C. B. Robins*	Lauraceae	VU
17.	*Nervilia plicata (Andr.) Schlechter*	Orchidaceae	EN
18.	*Peuraria tuberosa (Roxb. ex Willd.) DC.*	Fabaceae	EN
19.	*Phyllanthus emblica Gaertn*	Euphorbiaceae	VU
20.	*Pterocarpus marsupium Roxb.*	Fabaceae	VU
21.	*Rubia cordifolia L.*	Rubiaceae	VU
22.	*Thalictrum foliolosum DC.*	Ranunculaceae	VU
23.	*Uraria picta (Jacq) Desv.ex.DC*	Fabaceae	VU

VU = Vulnerable, EN = Endangered

Areas having biodiversity potential

During the survey it was observed that some areas are rich in biodiversity. These areas are rich in floral, medicinal, ethno botanical and cultural biodiversity. Important rare and threatened medicinal plants viz. *Bacopa monnieri*, *Centella asiatica*, *Costus speciosus*, *Embilia* rubusta., *Gloriosa superba*, *Gymnema sylvestre*, *Rubia cordifolia* and *Thalictrum foliolosum* are also found in these areas. Micro level plans can be prepared for their conservation. List of areas having biodiversity potential is given below;

Table – 7: Biodiversity potential areas

S.No.	Name of potential area	Block
1	Kabirchabutra	Karanjiya
2	Baigacheck	Bajag
3	Karanjiya	Karanjiya
4	Kharidih	Karanjiya
5	Bargaon	East Karanjiya
6	Jagatpur	East Karanjiya
7	Chauradadar	East Karanjiya
8	Makke	Shahpur
9	Kudwari	Shahpur
10	Ajwar	Shahpur
11	Chakrar	West Karanjiya

ACKNOWLEDGEMENTS

We take this opportunity to express our gratefulness and deep sense of gratitude to the Director, State Forest Research Institute, Jabalpur for his technical and moral support provided during the entire course of investigation. We are also thankful to Member Secretary of Madhya Pradesh State Biodiversity Board, Bhopal for providing financial assistance for the present task. We also convey our special thanks to DFO Dindori Forest Division along with their SDOs, Range Officers and local Field Staff for their kind cooperation, hospitality and support provided during the documentation of biodiversity status in their forest division.

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SCREENING AND PATHOGENICITY TEST OF LEAF SPOTS AND ROOT ROT CAUSING FUNGI OF *SHOREA ROBUSTA* (SAL)

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ABSTRACT

Shorea robusta (Sal) is an important tree species for production quality timber. An investigation was carried to study the fungal diseases of sal trees in Mandla and Anuppur Forest Division and four fungal pathogens were isolated which caused top drying. Samples were plated out on potato dextrose agar (PDA) medium and incubated at 28±2°C. Resulting growth microscopically screened for fungal species. *Aspergillus flavus* and *Rhizopus stolonifer* was commonest fungus found in both forest Divisions. Other genera like; *Rhizoctonia sp.* and *Curvularia lunata* were common in soil and root. These isolate were recovered from soil, root and leaves part of diseased mature plants. In pathogenicity test, *Curvularia lunata, Rhizoctonia sp.* and *Aspergillus flavus* isolates caused the top drying symptoms in Sal, while *Curvularia lunata* isolates caused leaf spots and root rots in plant of sal. Thus, *Curvularia lunata* and *Aspergillus flavus* was identified as the major cause of root rot disease in plant of sal in Madhya Pradesh region. Therefore, sal regeneration is gradually absence in its natural habitat.

INTRODUCTION

The genus *Shorea* Roxb. is rich in species diversity and *Shorea robusta* is one of the important species, belonging to the family Dipterocarpaceae. *Shorea robusta* is a tree commonly known as sal and is distributed in the forests of the tropical and some parts of subtropical. Sal forests are spread across 10 million hectare (m ha) in India. In addition to the Ayurvedic system of medicine, this tree is widely used in Unani medicine. Sal is an important tree species with high timber value. In India, it extends through the Eastern Ghats and to the eastern Vindhya and Satpura ranges of Madhya Pradesh. It is often the dominant tree in the forests where it occurs.

Sal forests are under threat by an insect infestation, popularly known as Sal borer (*Hoplocerambix spinicornis*). It kills trees silently with the only visible indications the sawdust collected at the stumps of the trees and also slows withering of the branches from the top of the tree. Within a short time the entire tree will dry up and die off. Also, die-

back of Sal seedlings due to attacks of some soil and liter decay fungi play an important role in regeneration failure of Sal forests. In its natural habitat sal (*Shorea robusta*) is susceptible to the attack of many parasitic fungi causing major or minor diseases. Some fungi are causes dying of sal in broad area. The major fungal diseases include those caused by *Polyporus shorea* and *Polyporus gilvus*. The semi-parasite *Loranthus scurrula* can also cause increment losses. *Cylindrocladium floridanum* and *C. scoparium* causing leaf spot and blight in *Shorea robusta* are reported from India. (Bakshi, 1976)

The present study aim is on isolation, identification and pathogenicity test of fungi responsible for top-drying or drying of sal trees in dominated forest area of East Mandla forest division and Anuppur forest division in Madhya Pradesh region.

Materials And Methods

Study Area –

The area chosen for study are Kotma range in Anuppur forest division and Motinala range in East Mandla forest division. Molinala forest range is big in area and near to the Kanha national park. Survey conducted in the month of June 2014 and Sept. 2014.

Sample collection:-

- Sample was collected from East Mandla Forest Division (Motinala rang) and Anuppur Forest Division (Kotma rang) in Madhya Pradesh.
- The rhizospheric soil sample was collected from 30cm, 60cm and 90cm deep by digging the soil near sal trunk.
- Diseased leaf and root samples were collected from top-drying Sal trees.

Procedure:-

1. **Isolation of Micro-Organisms From Root Sample**
   - Cut across lesions of 5 to 10 mm square, containing both the diseased & healthy looking tissue of root and leaf.
   - Surface sterilization of the cut pieces, by dipping in a surface sterilant solution (0.4% sodium hypochlorite(NaOcl)) for different times varying from 2 to 4 minute.
   - Wash the treated pieces in 3 times of sterile water & blot dry on clean, sterile paper towels to remove the sterilant.
   - The bits (3-5 pieces per plate) were then placed aseptically in sterile Petri- dishes containing Potato dextrose agar (PDA) medium.

- Incubate the inoculated plates, in an inverted position, at 28°C ± 2°C for 7-15 days.
- Isolation of fungi was done on Potato Dextrose Agar (PDA) Medium.

2. Isolation of Micro-Organisms From Soil Sample

Soil Dilution Plate Method:-

- 1 gms. of soil sample is taken in a 250 ml conical flask. To this is added 100ml of sterile water and the flask is vigorously shaken for a few minutes so that soil solution is obtained.
- This will represent 1:100 or 1ml of the supernatant of this 1/100 solution is taken and 9 ml of sterile water is added and the resultant solution will be 1/1000. In the same way, other dilution like 1/10,000 and 1/1,00,000 are made.
- One ml of desired dilution is poured into a sterile petridish and to this is added melted and cooled agar medium. The petridish is rotated by hand to disperse the medium and the soil suspension.
- The petri-dishes are then incubated at 28°C ± 2°C for a few days after which the growth of fungi takes place.

Pure Fungal culture:-

- Form this obtained by inoculating a single spore or a piece of mycelium on the agar medium in tube slants or in petir-dishes. The inoculated agar plate is covered and the tube slant is plugged with non-absorbent cotton wool. They are then placed in an incubator which is usually maintained at a temperature of 28-30^{0}C for a couple of days after which the agar plates and slants will show fungal growth in pure form.

Microscopic study:-

- For microscopic study slides were prepared in lactophenol cotton blue staining reagent and details of fungal, colonization in root and soil were observed and recorded under binocular microscope using 10x, 40x objectives.

Identification of fungi:-

- Fungi were identified on the basis of their growth characteristics, morphological characteristics and ontogeny with the help of manuals, monographs and taxonomic papers of various authors (Ellis,1971, 1976, Barnett and Hunter, 1972).

Pathogenicity test:-

The pathogenicity test of isolates was done by a root tip method (Namiki *et al* 1994). Single spore isolates were

grown in 500 ml Erlenmeyer flasks condition 250 ml PD broth at 28-30^{0}C for 5 days the resulting culture was passed through double- layered muslin cloth. Two to Three month old plants of sal were grown in plastic bag soil sterilizes by hot air oven at 80 ^{0}C for 6 hour consecutively for 2 days. Plants of sal with fully expanded leaves were used for pathogenicity test. The healthy plants were removed from the plastic bag, and their roots were washed gently with water. Plants were inoculated by dipping gently the root system in the above conidial suspension of each isolate for 5 min. The inoculated plants were transplanted in plastic bag. One plant per plastic bag was planted and three plastic bags were used for the individual isolated. In control plastic bag the plants were dipped in sterilized distilled water.

External symptoms and vascular discolouration were observed after inoculation. After 30 days of inoculation the pathogens were caused leaf spots disease and re-isolated from infected roots and leaves of inoculated plants. These were compared with isolated used originally to inoculate the plants. Predominant pathogen which took minimum time to express the disease symptoms after inoculation was used for further studies.

RESULT AND DISCUSSION

On the basis of this study four isolates of pathogen were recovered from diseased plant samples collected for major sal forest areas. Three common soil inhabiting fungi that cause root rots include *Curbularia lunata, Rhizopus sp.* and *Aspergillus flavus.* In this observation, the pathogenicity test was proved that leaf spots disease caused by *Curvularia lunata* and root rot symptoms were caused by *Curvularia lunata* and *Aspergillus flavus* results in drying in sal plants.

Symptoms - *Curvularia lunata* and *Aspergillus flavus* both fungi are capable of infecting healthy or uninjured roots and caused root rot disease and only *Curvularia lunata* is responsible for causing leaf spot disease in sal. Thes fungi have been isolated from leaves, soil and roots of sal. In many cases the dying trees become windthrown owing to root decay. The disease is correlated with high rainfall. The fungus infects through healthy uninjured roots, causing decay in the bark and sapwood. Heartwood is unaffected. The decay does not normally progress into the stem. Until the disease is worked out, control measures suggested include removal of dying and dead trees and practicing controlled burning to reduce soil moisture. *Curvularia lunata* and

Aspergillus flavus are very fast growing in rainy session or moist condition.

Characteristics of causal fungi of leaf spots and root rot disease –

1. ***Aspergillus flavus*** **-** The fungus was identified as *Aspergillus flavus*, based on the characteristic mixture of some colourless and dark conidia, produced in branched chains by conversion of the vegetative hyphae. Colonies dark blackish brown. Mycelium immersed and superficial. Colonies are 4.5-6.0 cm in diameter. Texture is lanose, margin white, centre yellowish. On basal mycelium sporulation is not dense. Sporulation is more at colony margin and centre. Conidial heads are blackish brown. Reverse bright yellow. Odour not distinct. There is zonation and mycelium is blackish yellow. Conidia are slightly rough, globose, yellow-brown and 5.0-8.0 µm in diameter.

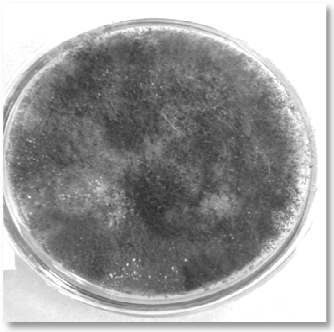

Fig.(1)

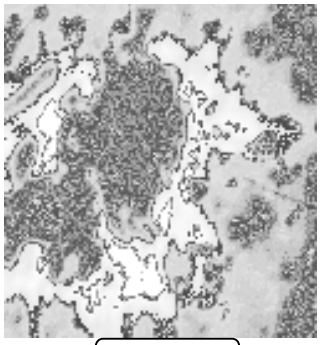

Fig.(2)

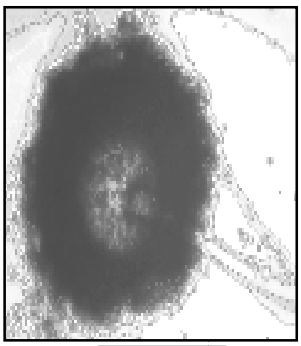

Fig.(3)

Fig 1- Growth of fungus on PDA medium after 7 days.
Fig. 3, 4- Conidia and conidiophor of *Aspergillus flavus*.

2. ***Curvularia lunata*** **-** The fungus was also identified as *Curvularia lunata*. Colony is brown, gray, or black, hairy, cottony or cushion-like and spreads loosely. Conidiophores arise singly or in groups, simple or rarely branched, straight or sometimes geniculate near the apex, brown to dark brown, multiseptate, variable in length, up to 5-6 µm diameter. Conidia are mostly 3-distoseptate, ellipsoidal to fusiform, or often disproportionately enlarged in the third cell and markedly geniculate or hook-shaped, pale to somewhat colored, almost concolorous, and smooth. Conidia are sparse in culture, and variable in shape and size among isolates.

Fig.(4)

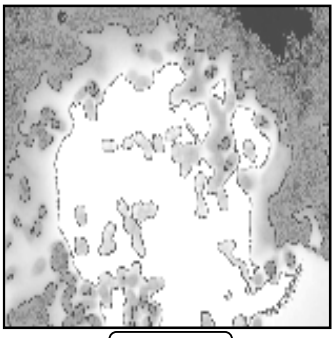

Fig.(5)

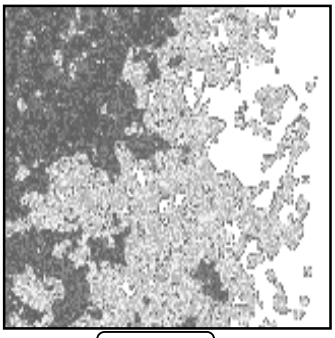

Fig.(6)

Fig 4- Growth of fungus on PDA medium after 7 days.

Fig. 5, 6- Conidia and conidiophor of *Curvularia lunata*.

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PHENOLOGY OF *ALANGIUM LAMARCKII* THW. (AKOLA)

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ABSTRACT

The present investigation presents the information regarding the phenological events of *Alangium lamarckii*. The results indicate that the leaf shedding starts in February and continued up to April. The initiation of new leaves starts from the month of April and continues till the end of June. The flowering was started in the month of February and completed till the end of April rarely continued up to May. The fruiting was initiated in the month of April and completed till the month of May and fruit fall was started in the month of June and completed till the end of July. Thus, leaf shedding, flowering; fruiting and leaf flushing events of *A. lamarckii* are completed during the dry season and fruit fall during rainy season.

Key word: Phenology, leafing, leaf fall, flowering, fruiting, fruit fall, Akola

INTRODUCTION

Alangium lamarckii Thwaites is generally known as Akola belongs to the Family Alangiaceae (old Family-Cornaceae). It is a deciduous shrub or small moderate tree with grey bark. Normally it attains the height about 3-10 m and girth up to 0.50 m which grows in the greater parts of Bundelkhand region of India. Akola is very important medicinal plants and being used as indigenous drugs by the people of village community (Ahirwar, 2012). The poultice of leaves is used in lumbago and juice of leaves used in piles and scorpion sting (Ahirwar, 2010, 2013). The wood of Akola is used for pestles of oil mills, agriculture implements and for house construction; also suitable for musical instruments, inlaying and ornamental and cabinet work (Naithani, 2008).

The term phenology was first used by Shelford (1929) to correlate the appearance of certain natural events. Daubemire (1947) defined phenology to include all studies on the relationships between climatic factors and the periodic phenomenon in plants. Phenological studies have been used for

studying the dispersal behaviour of seed in certain shrubs (Xiaojie *et al.,* 1999).

Phenology is the study of whole morphological changes in respect to the climatic change in the life cycle of a plant. The leafing, leaf shedding, flowering, fruiting, and fruit fall events are included under phenological study. The exact knowledge of phenological events of any woody plant may be helpful to improve the plantation. Therefore, the present study was undertaken to know the phenological events of *Alangium lamarckii*.

Material And Methods

To record the phenological events of *Alangium lamarckii*, the study site was visited regularly on a definite date of each month. The phenological characteristics such as leafing (Initiation and completion of leaf), leaf fall (Initiation and completion of leaf fall), flowering (Initiation and completion of flowering), fruiting (initiation and completion of fruiting), and fruit fall (initiation and completion of fruit fall) were recorded. The study was carried out for a period of one year from January to December.

Results And Discussion

The phenological observations (viz. leafing, leaf fall, flowering, fruiting and fruit fall behaviours) of *Alangium lamarckii* are presented in Tables-1.

Leafing-The initiation of new leaves in *Alangium lamarckii* starts from the month of April and continues up to June. Initially leaves were small and yellowish-green and colour of leaves turns into dark green later as depicted in Figure-2. The lower surface of young leaves covered with short and silky hairs. These leaves becoming larger in size, as result of which hairs are getting reduced in number. This leafing period of *Alangium lamarckii* commences since April and continues till the end of June. The period of leafing event can be divided into two categories e.g. Summer leafing and Rainy leafing. Thus it comes in the first category of leafing event. The *Alangium lamarckii* followed the similar pattern of leafing as stated by Krishnaswamy and Mathuda, 1954; Joseph, 1977; Tripathi, 1987; Kushwaha and Singh, 2005 in various other plants.

Leaf fall-The leaf shedding of *Alangium lamarckii* was initiated from February and completed till the end of April rarely continued up to May. The colour of leaves become yellow before the initiation of leaf fall as depicted in Figure-1. Verma *et al.* (2007) classified the tree species on the basis of initiation month, amount of leaf fall and duration of leaf fall into three categories (viz. Early winter defoliating, Mid-Winter defoliating and Late Winter-early

summer defoliating species). According to Verma *et al.* (2007) *Alangium lamarckii* known as late winter-early summer defoliating tree species.

Flowering-The flowering of *Alangium lamarckii* was started in the month of February and completed till the end of April, but in rare cases the flowering event remains continue till the month of May (Figure-1). Thus, flowering event of *Alangium lamarckii* was completed in summer season. Hence, it belongs to the first category (Bhatnagar, 1968). Chhangani (2004) recognized six type of flowering pattern e.g. (i) Summer (March-June) (ii) Summer-Monsoon (iii) Monsoon (July-October) (iv) Monsoon-Winter (v) Winter (November-February) (vi) Winter-Summer (vii) All Seasons.. None of these species included in last (seventh) category of flowering pattern. According to Chhangani (2004) *Alangium lamarckii* belongs to sixth category of flowering pattern because it has completed their flowering during winter-summer season.

Fruiting-The fruiting was initiated in the month of April and completed till the month of May as presented in Figure-2. The fruits are green initially, purplish red later and finally turns purplish black and fleshy. Chhangani (2004) also recognized the seven type of fruiting patterns viz. (i) Summer (March-June) (ii) Summer-Monsoon (iii) Monsoon (July-October) (iv) Monsoon-Winter (v)Winter (November-February) (vi) Winter-Summer (vii) All Seasons. According to classification of Chhangani (2004) the *Alangium lamarckii* belongs to the first category because it has completed their fruiting in summer season.

Fruit fall-The fruit fall of *Alangium lamarckii*, was started in the month of June and continued till the end of July. In rare cases the fruits may remain attached to their trees in August too, but the percentage of such trees as well as fruit is very negligible. Thus the fruit fall of this species occurs during rainy season.

Table-1: Different Phenological Events of *Alangium lamarckii*

Sr.	Phenological events	Month of Initiation	Month of completion
1	Leaf fall	February	April
2	Leafing	April	June
3	Flowering	February	April
4	Fruiting	April	May
5	Fruit fall	June	July

On the basis of foregoing discussion it is very clear that *Alangium lamarckii* completes their leaf shedding, leafing, flowering and fruiting events during the dry season and fruit fall during rainy season.

Fig.1: Leaf fall with flowering

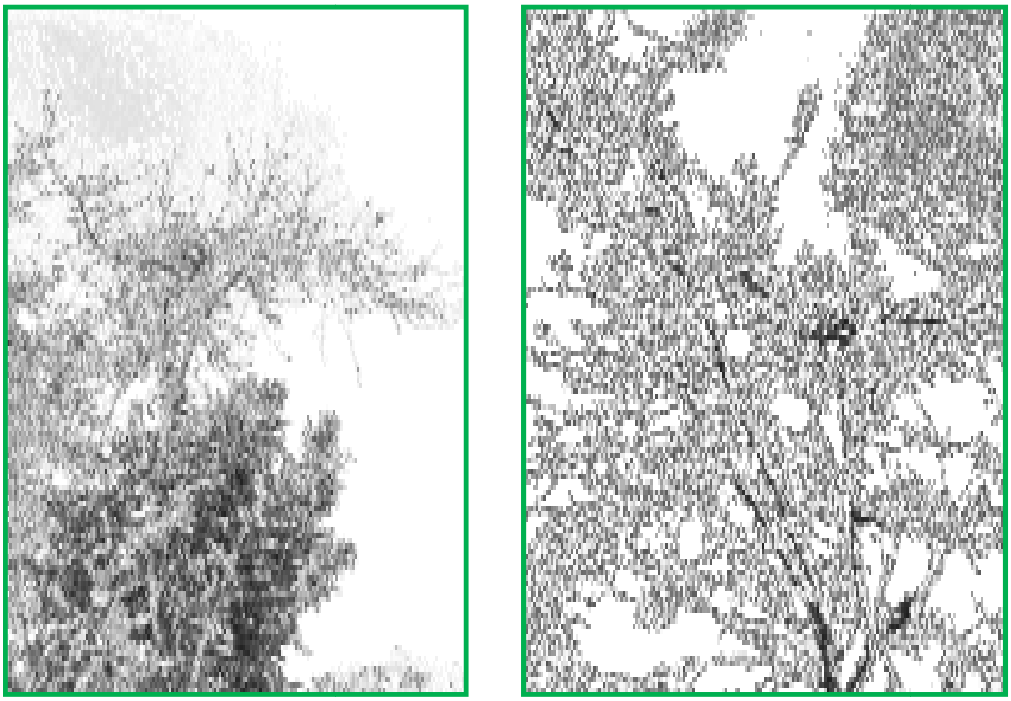
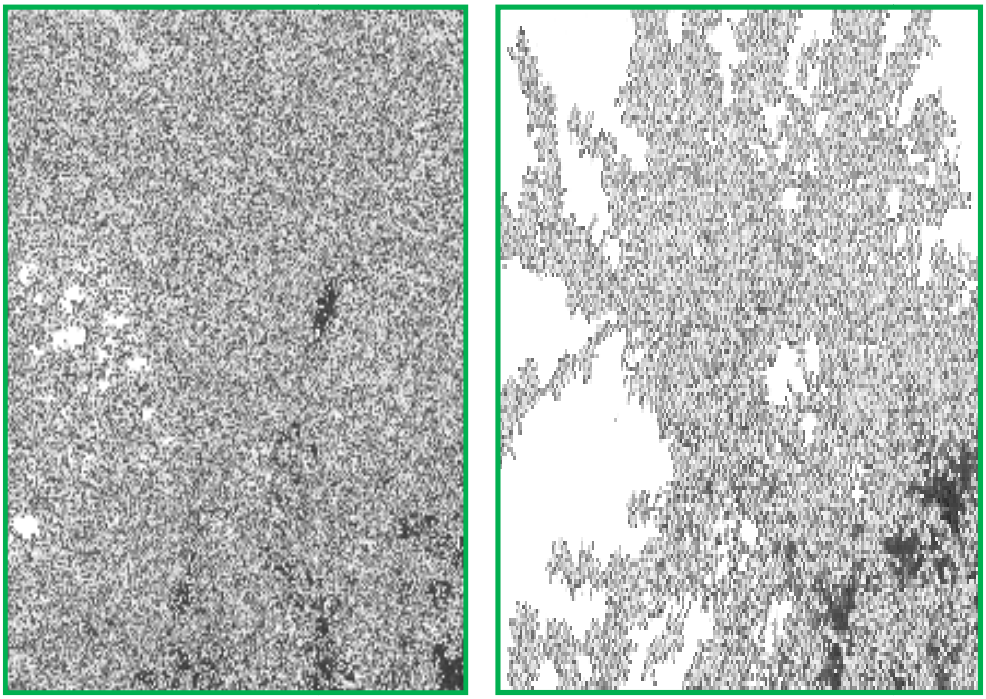


Fig. 2: Fruiting with leafing



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NATIVE AND EXOTIC INSECT PESTS OF EUCALYPTUS IN INDIA

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INTRODUCTION

Eucalyptus is usually regarded as an Australian tree and undoubtedly most successful world's exotic multipurpose fast grown tree species, which has already reached in more than 110 countries. The genus *Eucalyptus* (Family Myrtaceae) includes about 600 species and varieties. Eucalyptus has come to stay in India as commercial crops and extensive plantations have undertaken to meet the demands of fuel wood, timber and pulpwood, in various parts of the country including central India. Eucalyptus has a large complex of insects but only a few of them are serious pests of economic concern, both in native land and outside home (Nair, 2007).

Eucalyptus in India

Eucalyptus has a long history in India. It was first introduced around 1790 by Tippu Sultan, the ruler of Mysore, who received seeds from Australia and planted about 16 species in his palace garden on Nandi Hills near Bangalore (Sundar, 1984). Subsequent to the planting at Nandi Hills, the next significant introduction of *Eucalyptus* was in the Nilgiri hills, Tamil Nadu, in 1843. From 1856, regular plantations of *E. globulus* were raised to meet the demands for firewood (Wilson, 1972). The estimated area under eucalyptus in India is about 25,00,000 ha (www.icfre.gov.in). Over 10,00,000 ha of eucalyptus plantations have been established, mostly by State Forest Departments and Forest Development Corporations. Apart from these, around 6,000 million seedlings of eucalyptus have been planted in private lands (Sandhu, 1988). Some 170 species, varieties and provenance have been tried in India (Bhatia, 1984), out of which the most outstanding and favoured has been the *Eucalyptus* hybrid, a form of *E. tereticornis*, known as Mysore gum (Kushalappa, 1984, 1985). Other species which are grown on plantation scale are

E. camaldulensis, E. citridora, E. globulus and *E. grandis*. The potential productivity of eucalypt is around five tons of biomass/ha/yr on an average, but the average production is some 2.5 tons/ha/yr (Palanna, 1996).

Eucalyptus in Madhya Pradesh

Eucalyputs was first introduced in undivided Madhya Pradesh of central India on an experimental scale as early as 1865-66 and trials carried out on an around 70 species of *Eucalyptus* (Rajan, 1987). Large scale plantations of eucalyptus covering an area of 67,472 ha have been raised in between the years 1956 and 1982. The promising eucalypt species of the states are *E. citridora* followed by *E. camaldulensis* and *E. tereticornis* (Dutta, 1984).

Insects associated with Eucalyptus :

The first publications devoted to insect herbivores associated with eucalyptus in Australia have written by French (1900) and Froggatt (1923). The diversity of insects associated with eucalyptus in Australia's native forests is very large. The insect herbivory on eucalyptus has been reviewed thoroughly by Ohmart and Edwards (1991). Around 400 insect species have been mentioned, comprising chiefly of 160 species of foliage feeders, 110 species of xylophagous borers, 76 species of sap-suckers, 32 species of timber borers and 22 species of miscellaneous insects (Mathur and Singh, 1959; Singh and Singh, 1975; Nair et al., 1986; Tewari, 1992). Recently, Nair (2007) has mentioned 920 species of insects associated with eucalyptus which is world total, including those from the temperate region. However, most of the insect fauna associated with eucalyptus comprises only casual feeders, having little economic status.

In India, like other exotics, eucalyptu also suffers in varying degree, from light to heavy mortality due to insect attack. Some of the native phytophagous pests, because of prolonged ecological association with eucalyptus, over the years, have developed fancy for this exotic and have adopted eucalyptus as a favourable hosts. As of today, a good number of insects have been found associated with different species of *Eucalyptus* in India causing debility/injury in varying degree (Tewari, 1992). Of these, stem and root borer, *Celosterna scabrator* Fabricius (Coleoptera : Lamiidae) (Chatterjee and Singh, 1968) and some species of termites, *Odontotermes* spp. (Isoptera : Termitidae) (Thakur and Sen-Sarma, 1982; Thakur, 1988) have been recognized as key pests. Regarding exotic pests, a few Australian insect

species have inadvertently been introduced into many eucalypts growing countries of the world where they have established themselves as recognized pests, in varying degree of economic status (Roychoudhury et al., 2008). A good number of exotic insects have gained entry into India, such as *Aphis gossypii* (Glover) (Hemiptera : Aphididae), *Icerya purchasi* Maskell (Hemiptera : Margarodidae) and *Orthezia insignis* (Browne) (Hemiptera : Ortheziidae). A large number of species of *Eucalyptus* have proved highly susceptible to attack by these introduced species, which at times result in the death of young plants/seedlings.

Until recent years, eucalyptus has been considered virtually free from serious insect pests in its home land and outside Australia. The eucalyptus borer, *Phoracantha semipunctata* (Fabricius) (Coleoptera : Cerambycidae), is a minor pest attacking mainly drought weakened trees (Mendal, 1985). However, eucalyptus in its new habitats has been under assault from a constant stream of specific phytophagous insect pests originated from their home land (Withers, 2001). Six species of gall making wasps have established themselves on eucalyptus outside Australia, viz. *Quadrastichodella nova* Girault (Hymenoptera : Eulophidae) (Flock, 1957; Timberlake, 1957), *Epichrysocharis burwelli* Schauff (Hymenoptera : Eulophidae) (Schauff and Garrison, 2000), *Ophelimus eucalypti* (Gahan) (Hymenoptera : Eulophidae) (Bain, 1977; Withers et al., 2000; Viggiani and Nicotina, 2001), *Aprostocetus* sp. (Hymenoptera : Eulophidae) (Beardsley and Perreira, 2000), *Nambouria xanthops* (Hymenoptera : Pteromalidae) (Berry and Withers, 2002) and *Leptocybe invasa* Fisher & LaSalle (Hymenoptera : Eulophidae) (Mendal et al., 2004). It is interesting that several of these invasions have occurred since 1990.

Until the year 2000, eucalyptus gall wasp, *Leptocybe invasa* Fisher & LaSalle (Hymenoptera : Eulophidae), has unknown in its home land and outside Australia where this tree species has been introduced (Mutitu, 2003). *L. invasa* is a new genus of tiny wasp responsible for gall formation in *Eucalyptus* (Mendel et al., 2004). This gall insect is native to Queensland, Australia, although its distribution there is not yet determined (FPSP, 2012). This eucalyptus gall insect has been first recorded in the Middle East during the year 2000 (Aytar, 2003). Currently, the wasp is reported from Algeria, Brazil, Cambodia, China, Ethiopia, France, Greek, India, Iran, Iraq, Israel, Italy, Jordan, Kenya, Morocco,

New Zealand, North America, Portugal, Spain, Syria, South Africa, Tanzania, Thailand, Turkey, Uganda and Vietnam (Branco et al., 2005, 2006; Nyeko, 2005; Aytar, 2006; Kim et al., 2008; Wiley, 2008; Gaskill et al., 2009; Dhahri et al., 2010; Karunaratne et al., 2010; Aquino et al., 2011).

In India, *L. invasa* has been first noticed in 2001 at Mandya district in Karnataka, and later in 2002 at Marakkanam in Villupuram district of Tamil Nadu and then, it has spread over to peninsular India (Anon, 2007a,b; Jacob et al., 2007). Recently, only during the month of April-May, 2007, this alien forest invasive species has been noticed for the first time in nurseries of central India and subsequently to young plantations of eucalyptus (Roychoudhury et al., 2007). The outbreak of this exotic pest in peninsular India has concomitantly changed the scenario by affecting the vast areas of this potential crop (Jacob and Prakash, 2008, Jacob, 2009). Inadvertent recent entry of this gall insect threatens eucalyptus in nurseries and plantations across the country in large scale (Sharma et al., 2007; Akhtar et al., 2008; Jhala et al., 2009; Senthilkumar et al., 2013a,b). Presently, this alien forest invasive insect species is inflicting eucalypts in large scale all over the country, including central India (Roychoudhury, 2009, 2013).

Thus, from the above account it is clear that there is an urgent need of long term strategies to combat gall insect to prevent its spread. Interim decisions and control efforts need to focus on minimizing spread, using silvicultural practices fully integrated and complemented with chemical control where feasible.

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बांस आधारित कृषि वानिकी में फसलोत्पादन एवं मृदा संरक्षण

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सारां

बांस प्रजातियाँ *डैन्ड्रोकैलेमस स्ट्रीक्टस, बम्बूसा बम्बोसा* एवं *बम्बूसा न्यूटन्स* को तीन विभिन्न दूरियों ३X४ मी., ४X५ मी. एवं ५X६ मी. पर वर्ष १९९६ में रोपित कर सोयाबीन एवं गेहूँ, अन्तः फसल के रूप में वर्ष १९९७.२००१ तक टी. एफ. आर. आई., जबलपुर (म.प्र.) के समीप परिक्षण किया गया। सोयाबीन की उत्पादकता बांस कृषि वानिकी पद्धति के अंतर्गत प्रथम वर्ष में बांस दूरी ५X६ मी. एवं ४X५ मी. के अंतर्गत ११.३७ क्विं./है. *डैन्ड्रोकैलेमस स्ट्रीक्टस* तथा ११.०९ क्विं./है. *बम्बूसा न्यूटन्स* में बांस दुरी ५X६ मी. मै व चतुर्थ वर्ष दौरान सोयाबीन उत्पादन में वृद्धि पायी गई जो अधिकतम १६.३७ क्विं./है. जो ५X६ मी. दुरी पर बांस *डैन्ड्रोकैलेमस स्ट्रीक्टस* में पायी गई जो केवल सोयाबीन उत्पादन (ओपन) से अधिक था। *बम्बूसा बम्बोसा* में सोयाबीन उत्पादन समस्त स्थानों व दूरियों पर *डैन्ड्रोकैलेमस स्ट्रीक्टस* एवं *बम्बूसा न्यूटन्स* के अपेक्षाकृत कम पाया गया। बांस प्रजातियों, दूरी एवं स्थानीयता का चतुर्थ वर्ष में फसलों की उपज पर प्रभाव कम बांस दूरी विशेष रूप से ३X४ मीटर व ४X५ मीटर में गेहूँ उत्पादन में क्रमशः 24 प्रतिशत तथा १६ प्रतिशत घटोत्तरी पायी गई । किन्तु ५X६ मी. की बांस दूरी पर अन्तः फसल गेहूँ के उत्पादन में बढ़ोत्तरी ७३ प्रतिशत से लेकर २३ प्रतिशत तक विभिन्न स्थानों पर प्राप्त हुई।

परिचय

दे ा की बढ़ती हुई जनसंख्या की आव यकताओं के लिये पृथक से कृषि योग्य भूमि एवं क्षेत्रफल बढ़ाकर उत्पादन वृद्धि संभव नही है साथ ही दे ा का भौगोलिक क्षेत्रफल वि व का मात्र 2.4 प्रति ात है जिससे वि व की 16 प्रति ात जनसंख्या तथा 15 प्रति ात प ुसंख्या को प्राणवायु, स्वच्छ जल, भोजन, हरा चारा,

आवास एवं प्रदूषण रहित पर्यावरण उपलब्ध कराना है। यह आपूर्ति जो केवल अब प्राकृतिक वनों के द्वारा होना संभव नही है। कृषि वानिकी एक परम्परागत विधि है जिसके तहत वन, कृषि एवं प ुओं का समग्र विकास किया जा

सकता है। कृषिवानिकी भूमि प्रबंधन की ऐसी पध्दति है जिसके तहत एक ही भूखंड पर फसलों, वृक्षों/झााड़ियों एवं प ाुपालन एक क्रमबद्ध तरीके से सम्मिलित किये जाते हैं जो वैज्ञानिक विधि से सृदृढ़, पर्यावरणीय वांछित, प्रयोग करने में सही तथा किसानों को स्वीकार्य हो (नायर, १९८२; लीके, १९९६)। जिससे उत्पादन बढ़ाने के अलावा बहुउद्दे ाीय लाभ जैसे पारिस्थिकीय संतुलन, पर्यावरण स्थिरता एवं जैव विविधता का संरक्षण व खाद्यान की पूर्ति की जा सकती है। साथ ही कृषिवानिकी ऐसी भूमि पर अपनायी जा सकती है जहॉ कृषि फसलों की खेती करना लाभदायक नही है। कम उपजाउ भूमि पर कृषिवानिकी अपनायी जा सकती है जिसमे वृक्षों अन्तर्गत अन्तः खाली स्थान पर उपयुक्त कृषि फसलों का समावेश कर खेती से कई समस्याओं को दूर किया जा सकता है। इस पद्वति से जल का संचयन, भूमि क्षरण एवं कटाव में रोक, सूखा व अकाल से मुक्ति, बाढ को संतुलित करने तथा पर्यावरण को सुधारने में सहायक होती है साथ ही इससे जलाउ लकडी, इमारती लकडी, कंदमूल, फूल, फल, जीवनदायिनी जडी–बूटियां, चारा एवं विभिन्न प्रकार के वनोपज व लधुवनोपज की मांग की पूर्ति भी संभव है।

सोयाबीन एवं गेहूँ मध्यप्रदे ा में ऊगाई जाने वाली प्रमुख फसलों में से है। प्रदेश की मध्य क्षेत्र की जलवायु इन फसलों की पैदावार हेतू अनुकूल व उपयुक्त है। प्रदे ा में अनुपजाऊ एवं पड़ती भूमि का रकबा ५७१३४.०३ वर्ग कि.मी. है जो उच्चत्तम फसलोंत्पादन की दृष्टि से लाभदायक नही है। ऐसी स्थिति में कृषिवानिकी एक ऐसा माध्यम है जिसके द्वारा लकड़ी एवं अन्न दोनों का उत्पादन साथ–साथ एक इकाई भूमि में किया जा सकता है। इस पद्धति द्वारा लकड़ी, अन्न उत्पादन के साथ–साथ भूमि सुधार भी किया जा सकता है। प्रदे ा में बांस की विभिन्न प्रजातियाँ पाई जाती है जिसमें *डैन्ड्रोकैलेमस स्ट्रीक्टस, बम्बूसा बम्बोसा* एवं *बम्बूसा न्यूटन्स* प्रमुख हैं। परीक्षण में बांस प्रजातियों के अंतर्गत प्रचलित कृषि फसलों की खेती कर फसलोत्पादन एवं भूमि संरक्षण का प्रयास किया गया।

अध्ययन विधि एवं सामग्री

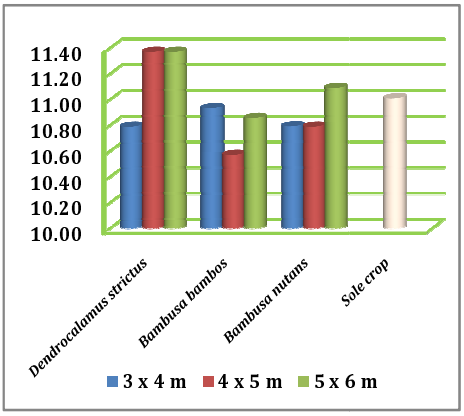
यह परीक्षण टी.एफ.आर.आई. जबलपुर परिसर के समीप सन् 1998 से 2001 तक विभिन्न मृदाओं व स्थानो पर बांस की तीन प्रजातियाँ डैन्ड्रोकैलेमस स्ट्रीक्टस, बम्बूसा बम्बोसा एवं बम्बूसा न्यूटन्स जिन्हें तीन विभिन्न दूरियों ३X४ मीटर, ४X५ मीटर एवं ५X६ मीटर पर वर्ष १९९६ में रोपित कर किया गया। सोयाबीन

एवं गेहूँ, प्रदे ा में ऊगाई जाने वाली प्रमुख फसलों का उत्पादन रोपित बांस प्रजातिओं की विभिन्न दूरियों ३X४ मीटर, ४X५ मीटर एवं ५X६ मीटर में अन्तः फसल के रूप में वर्ष १९९७.२००१ तक किया गया। प्रत्येक स्थान जो तीन विभिन्न मृदाओं के कारण उपलब्ध था इन प्रत्येक स्थानों पर अनुसंधान दौहरा कर लगातार तीन वर्षों (१९९७.२००१) तक परीक्षण किया गया। प्रत्येक बांस प्रजाति और दूरी में २५ बांसों को पांच पंक्तियों में समाहित कर परीक्षण किया गया।

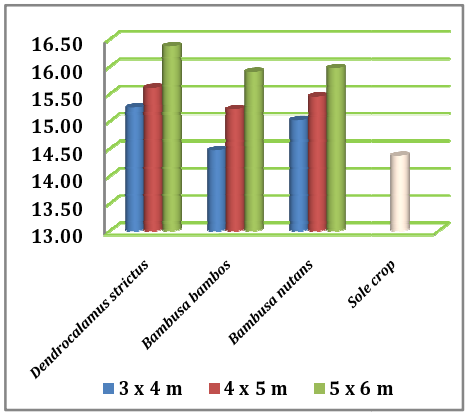
परिणाम व विवेचना

बांस की विभिन्न प्रजातियों तथा बांस दूरियों के बीच कृषि फसलों का अध्ययन तीन वर्षों तक लगातार अवलोकन व परीक्षण किया गया एवं प्राप्त आंकड़ों का सांख्यिकी विश्लेषण तालिका (१ से २) में एवं उपज का प्रदर्शन व प्रवृति चित्र (१ से २) में द ार्या गया है। बांस आधारित कृषिवानिकी के अन्तर्गत सोयाबीन उपज (क्विं./है.) पर बांस प्रजाति एवं दूरी के प्रभाव का तुलनात्मक प्रदर्शन चित्र (१) से यह देखा जा सकता है कि सोयाबीन की उत्पादकता बांस कृषि वानिकी पद्धति के अंतर्गत प्रथम वर्ष ५x६ मी. एवं ४x५ मी. बांस दुरी के अंतर्गत ११.३७ क्विं./है. *डैन्ड्रोकैलेमस स्ट्रीक्टस* तथा ११.०९ क्विं./है. *बम्बूसा न्यूटन्स* बांस दुरी ५x६ मी. में पायी गयी जो केवल सोयाबीन उत्पादन (ओपन) से अधिक पाया गया ।

चित्र (1): बांस आधारित कृषिवानिकी के अन्तर्गत सोयाबीन उपज (क्विं./है.) पर बांस प्रजाति एवं दूरी के प्रभाव का तुलनात्मक प्रदर्शन।

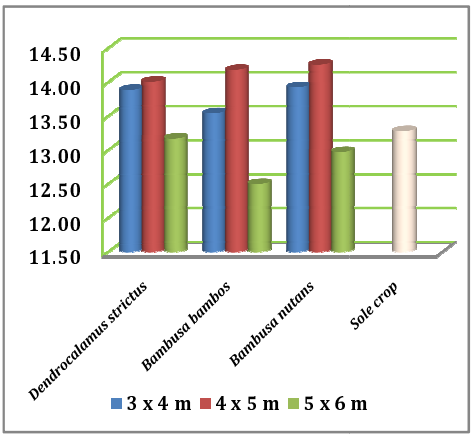


(प्रथम वर्ष में)

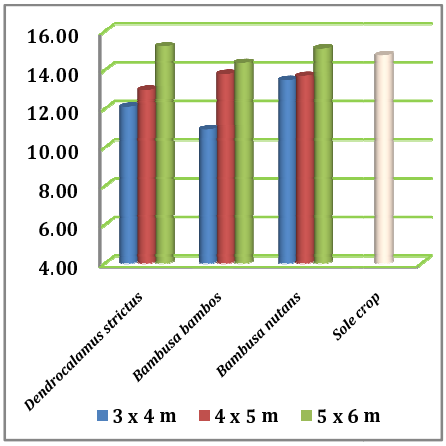


(चतुर्थ वर्ष में)

चित्र (2): बांस आधारित कृषिवानिकी के अन्तर्गत गेंहूँ उपज (क्विं./है.) पर बांस प्रजाति एवं दूरी के प्रभाव का तुलनात्मक प्रदर्शन।



(प्रथम वर्ष में)



(चतुर्थ वर्ष में)

इस पद्धति में परीक्षण दौरान चतुर्थ वर्ष में सोयाबीन उत्पादन बांस कृषि वानिकी के अंतर्गत उत्पादन में वृद्धि पायी गई जो अधिकतम १६.३७ क्विं./है. ५x६ मी. बांस दुरी पर *डैन्ड्रोकैलेमस स्ट्रीक्टस* में पायी गई (चित्र 1) जो केवल सोयाबीन (ओपन) उत्पादन की अपेक्षा १३.६ प्रतिशत अधिक था। इसी प्रकार गेहू की उत्पादकता बांस कृषिवानिकी के अंतर्गत प्रथम वर्ष केवल गेहू (ओपन) की अपेक्षा अधिक पायी गयी केवल बम्बूसा बम्बॉस (५x६ मी.) को छोड़कर जहाँ गेहू उत्पादकता १२.५० क्विं./है. मात्र थी (चित्र–2) परन्तु गेहू उत्पादकता बांस आधारित कृषि वानिकी में विशेष रूप से ३x४ मी. तथा ४x५ मी. बांस दुरी पर गेहूँ उत्पादकता केवल गेहू (ओपन) की अपेक्षा कम पायी गयी जो २५.६ प्रतिशत से ६.५ प्रतिशत थी।

कृषि फसलों पर बांस प्रजातियों, दूरी एवं स्थानीयता का प्रभाव तालिका (१ व २) में प्रदर्शित किया गया। सोयाबीन उपज पर प्रभाव के परीक्षण तथा आकंड़ों के अध्ययन से यह प्रदर्शित होता है कि अध्ययन क्षेत्र में बांस आधारित कृषि वानिकी के अन्तर्गत चतुर्थ वर्ष में सोयाबीन उपज सभी बांस दूरियों, प्रजातियों, एवं स्थानीयता में उत्पादन क्रम I: १३.२५, १३.५० व १४.२२ क्विं./है. पाया गया जो

ओपन की तुलना में अधिक पायी गई तालिका (१) परीक्षण से प्राप्त आंकड़ों का सांख्यकीय विश्लेषण से यह प्रदर्शित होता है की चतुर्थ वर्ष में बांस अंतर्गत सोयाबीन उत्पादन किया जा सकता है (तालिका १) अनुसंधान में यह भी पाया गया कि *बम्बूसा बम्बोसा* में सोयाबीन उत्पादन समस्त स्थानों व दूरियों पर *डैन्ड्रोकैलेमस स्ट्रीक्टस* एवं *बम्बूसा न्यूटन्स* के अपेक्षाकृत कम पाया गया।

तालिका (१): बांस आधारित कृषिवानिकी के अन्तर्गत चतुर्थ वर्ष में बांस प्रजाति, दूरी एवं स्थानीयता का सोयाबीन उपज पर प्रभाव

Spacing	Locality	*Dendrocalamus strictus*	*Bambusa bambos*	*Bambusa nutans*	Sole crop	SE(m)±	CD (0.05)
3x4	I	14.40	14.17	14.42	13.17	0.103	0.25
	II	17.77	16.00	17.77	16.34	0.089	0.22
	III	13.57	13.25	13.50	13.17	0.059	0.14
	Species x localities interaction					0.051	0.12
4x5	I	14.62	14.22	14.60	13.17	0.204	0.49
	II	18.27	17.92	18.15	16.34	0.103	0.25
	III	13.92	13.50	13.60	13.17	0.184	0.45
	Species x localities interaction					0.095	0.19
5x6	I	15.72	15.10	15.30	13.17	0.069	0.17
	II	18.85	18.37	18.37	16.34	0.091	0.22
	III	14.52	14.22	14.22	13.17	0.131	0.32
	Species x localities interaction					0.058	0.12
Interaction between the species x locality x spacing						0.043	0.09

कृषि फसलों पर बांस प्रजातियों, दूरी एवं स्थानीयता का गेहूँ उपज पर प्रभाव तालिक (२) में प्रद ित किया गया। आकंड़ों के अध्ययन से यह देखा जा सकता है कि अध्ययन क्षेत्र में बांस आधारित कृषि वानिकी के अन्तर्गत चतुर्थ वर्ष में कृषि फसलों की उपज पर प्रभाव कम बांस दूरी वि ोष रूप से ३X४ मीटर

व ४X५ मीटर में गेहूँ का उत्पादन क्रम ः १०७२५ क्विं./है. व १२७०७ क्विं./है. पाया गया जो ओपन की तुलना में 3X4 मी. बांस दूरी में 24 प्रतिशत तथा ४X५ मी. में १६ प्रतिशत घटोत्तरी पायी गई (तालिका १)। अतः समीपस्थ दूरियों पर गेहूँ की फसल का उत्पादन में घटोत्तरी हुई परन्तु ५X६ मी. की बांस दूरी पर अन्तः फसल गेहूँ के उत्पादन में बढ़ोत्तरी १७३ प्रतिशत से लेकर 23 प्रतिशत तक विभिन्न स्थानों पर प्राप्त हुई। अनुसंधान में यह भी पाया गया कि *बम्बूसा बम्बोसा* में गेहूँ फसल उत्पादन समस्त स्थानों व दूरियों पर *डैन्ड्रोकैलेमस स्ट्रीक्टस* एवं *बम्बूसा न्यूटन्स* के अपेक्षाकृत कम पाया गया। चतुर्थ वर्ष में बांस प्रजाति, दूरी एवं स्थानीयता का गेंहूँ उपज पर पारस्परिक क्रिया व प्रभाव से प्राप्त आंकड़ों का सांख्यकीय विश्लेषण तालिका (१) में प्रदर्शित किया गया है अवलोकन उपरांत उत्पादन कम हो रहा है।

तालिका (२): बांस आधारित कृषिवानिकी के अन्तर्गत चतुर्थ **वर्ष में बांस प्रजाति, दूरी एवं स्थानीयता का गेंहूँ उपज पर प्रभाव**

Spacing	**Locality**	***Dendrocala mus strictus***	***Bambusa bambos***	***Bambusa nutans***	**Sole crop**	**SE(m)±**	**CD (0.05)**
3x4	I	11.34	11.40	13.25	14.32	0.035	0.09
	II	13.22	11.15	14.35	16.43	0.086	0.21
	III	11.75	10.25	12.82	13.50	0.057	0.14
	Species x localities interaction						
4x5	I	12.32	12.07	12.27	14.32	0.033	0.08
	II	14.39	15.85	15.47	16.43	0.035	0.21
	III	12.20	13.47	13.35	13.50	0.049	0.14
	Species x localities interaction						
5x6	I	14.85	13.55	15.33	14.32	0.059	0.14
	II	16.65	16.15	16.35	16.43	0.085	0.21
	III	13.50	13.42	13.67	13.50	0.031	0.08
	Species x localities interaction						

Interaction between the species x locality x spacing		

पद्धति में चतुर्थ वर्ष के दौरान उपज में कमी आने के प्रमुख कारण सूर्य प्रका ा, पानी एवं पोषक तत्वों के लिये कृषिवानिकी वृक्षों एवं खाद्यान्न फसलों में प्रतिस्पर्धा जो अन्तः फसलों के उत्पादन में धीरे–धीरे कमी लाती है (तालिका २)। अतः ऐसी द ा में ऐसी फसलों का चुनाव करना चाहिये जो छाया में भी हो सके। ऐसी अवस्था में हमारे लिये औषधीय एवं सगंध पौधों की खेती कृषिवानिकी में अपनाना चाहिये जो एक लाभदायक साबित हो सके। बांस आधारित कृषिवानिकी से न केवल प्रति इकाई उत्पादनता को बढ़ाया जा सकता है और साथ–साथ पेड़ों की बढ़वार से मृदा क्षरण कम किया जा सकता (तालिका १ व २)।

बांस आधारित कृषि वानिकी के द्वारा भूमि क्षरण पर प्रभाव पर किया गये परीक्षण के आंकड़ों को तालिका में दर्शाय गया है जिसे परीक्षण स्थल पर जल निकास बिन्दुओं से प्रत्येक स्थान, बांस दूरियां तथा अंतः फसलों व खाली बांस आधारित रोपण के प्रथम तथा चतुर्थ वर्ष में अवलोकन व निरिक्षण, जल निकास नलियां निर्मित कर जल बहाव एकत्रित कर प्रयोगशाला में मृदा का आंकलन कर यह पाया गया कि बांस आधारित कृषि वानिकी से मृदा क्षरण विभिन्न स्थानो वं विभिन बांस दूरियों के अंतर्गत कृषि फसलों के साथ प्रारंम्भिक वर्ष की तुलना में चतुर्थ वर्ष में ४३ से ४६ प्रतिशत तक कम पाया गया तथा केवल बांस के अंतर्गत मृदा क्षरण ५० प्रतिशत तक कम पाया गया तालिका (३)।

तालिका (३): बांस आधारित कृषिवानिकी का भूमि क्षरण (मिली ग्राम/लीटर पानी) पर प्रभाव

Locality	**Initial soil loss July 1995**	**Cropping pattern**	**June- July 1999**		
			3 x 4	**4 x 5**	**5 x 6**
Dendrocalamus strictus					
I	487	Sole crop	252	272	292
		Inter crop	214	244	254
II	423	Sole crop	195	205	225
		Inter crop	161	172	183
III	526	Sole crop	285	295	306

		Inter crop	252	260	275
Bambusa bambos					
I	487	Sole crop	221	222	249
		Inter crop	201	214	226
II	423	Sole crop	164	195	202
		Inter crop	142	156	169
III	526	Sole crop	202	239	263
		Inter crop	174	281	230
Bambusa nutans					
I	487	Sole crop	248	276	302
		Inter crop	216	244	259
II	423	Sole crop	214	247	267
		Inter crop	178	209	235
III	526	Sole crop	276	248	289
		Inter crop	295	213	253
Soybean +wheat rotation					
I		Sole crop	335	335	335
II		Sole crop	320	320	320
III		Sole crop	350	350	350
SE+(m)					
CD(0.05)			71df		25.26

- *The average rainfall per annum on 60 years basis is 1300 mm. Therefore, mg/liter when multiplied with, by a factor of 13 will give soil loss in kg/ha/year, or 0.013 will give soil loss in t/ha/year*

इस भूमि प्रबंधन पद्धति से मृदा जल संरक्षण ११ से ४५ प्रतिशत तक रिकॉर्ड किया गया। खैबरी एवं साथी (१९९२), डढ़वाल (१९८६) ने भी पेड़ो की दूरी का फसलों पर प्रभाव के अधययन में फसलो पर प्रभाव देखा गया ।

मीणा १९९८ एवं सूरजभान, १९९७ ने प्रयोगो में पाया कि सेंचरश

सेलिअरिस का प्रयोग भूमि एवं जल संरक्षण के कार्य हेतु बहुत अच्छी तरह सुगमता से किया जा सकता है क्योंकि घांस की जड़ों में मृदा कणों को आपस में बंधने की शक्ति होती है सूरजभान १९९७ में यह पाया की दलहनी व अदलहनी फसलों में घांस अंतः फसल के रूप में उगने से भूमि की सतह से मृदा व जल अपरदन को कम किया जा सकता है एवं फसलों की पैदावार में वृद्धि पाई गई। परीक्षण में यह पाया गया कि इन कृषि फासलो की खेती चतुर्थ वर्ष में भी बांस के साथ लगातार की जाती है तो फसलोत्पादन में कमी आती है जिसकी भरपाई बांस के उत्पादन एवं भूमि क्षरण को घटा कर की जा सकती है जिससे भूमि प्रबंधन एवं संरक्षण किया जा सकता है। इस बांस व गेंहूँ एवं सोयाबीन की फसलों पर आधारित कृषिवानिकी पद्धति से भूमि की उर्वरकता तथा भूमि क्षरण एवं कटाव को रोका जा सकता है (तालिका ३)।

निष्कर्ष

बांस आधारित कृषिवानिकी अनुसंधान से यह सिद्ध होता है कि बॉस के बीच गेहूँ तथा सोयाबीन अन्तरवर्तीय फसलें प्रारंभिक वर्षों के लिये उपयुक्त हैं। कृषि वानिकी, भूमि उत्पादन प्रणाली की पारिस्थितिकी सुरक्षा के लिए सबसे किफायती, टिकाऊ और स्थिर विकल्प है। अतः बांस आधारित कृषि वानिकी को अपना कर भूमि की रोकथाम एवं पारिस्थिकीय, पर्यावरणीय सुरक्षा के अलावा खाद्यान तथा पोषक सुरक्षा भी निश्चित की जा सकती है। बदलते मौसम, जलवायु परिवर्तन के दौर में कृषि वानिकी से किसानों की आर्थिकी को मजबूत करने के लिए यह परियोजना राष्ट्रीय कृषि विकास में महत्वपूर्ण स्थान रखती है। बांस आधारित कृषिवानिकी की खेती अपनाकर इन समस्याओं को दूर किया जा सकता हैं।

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