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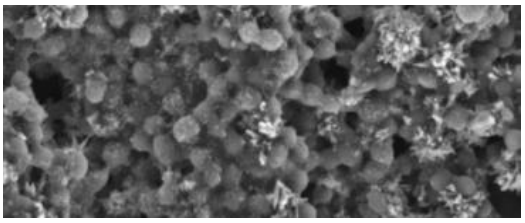
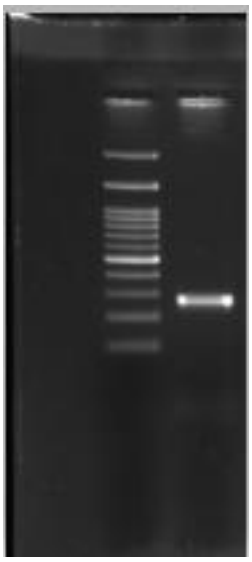

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From the Desk of Editor-in-chief

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I would like to introduce the launch of **"AgriGate - An International Multidisciplinary Monthly e-Magazine Volume 02 Issue No. 04 – April 2022"** with immense pleasure. Our team is privileged to dedicate this issue to Dr. B. R. Ambedkar Rao for his remarkable contributions to social empowerment.

The main objective of the magazine is to provide a publishing platform for young researchers and scientists as well as an information hub for the enthusiast, progressive farmer and also common readers. We envisage providing an online platform that appreciates illuminating articles on various topics related to agriculture and allied sciences monthly that will appraise and update the students, farming community and the whole society at large on the updates in agriculture.

Last but not the least, I wholeheartedly thank the editorial team, authors as well as anonymous reviewers for contributing to the release of this issue.

Our team welcomes your constructive feedback and suggestions to improve delivering fruitful content to hungry minds.

Dr R Shiv Ramakrishnan
Editor-in-chief
AgriGate Magazine

Volume: 02 Issue No: 04

AGROFORESTRY IN BIOREMEDIATION OF PROBLEMATIC SOILS

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Introduction

Problematic soils are those soils which are not suitable for arable farming because of specific limitations. Agroforestry is the collective name for all land use systems in which woody perennials are deliberately grown with agriculture crops and/or animals either in some form of spatial or temporal sequence. "Remediate" means to solve a problem and "Bio-remediation" means to use biological organisms for solving an environmental problem such as contaminated soil or groundwater. In agroforestry system there must be ecological and economic interaction between the components. Agroforestry systems have the potential to make use of marginal and degraded lands through the soil improving effects of trees (Lundgren and Rain tree, 1982).

Trees, whose roots reach deep into the underlying rock of most northeastern soils, break that rock down with both the mechanical force of root pressure and the chemical force of humic acids. They then take up the resulting minerals and other nutrients into their biomass as trunk, branches, leaves, roots, etc. Event ually this material is deposited back in t he forest floor asorganic matter to build the soil. Over a lifetime, trees shed many times their own mass to the soil in which they grow. Trees have evolved in combination with another complex form of life, fungi.

Mushroom their mycelia form a complex forking network of interwoven strands of cells that grow beyond the immediate tree's root zone, extending, in extreme cases, over many acres. The mycelia content of topsoil in a Pacific Northwestern Douglas Fir forest has been estimated to be as much as 10% of biomass! Each mycelium gives off enzymes which unlock organic compounds in the surrounding matrix, releasing carbon, nitrogen and other elements that are then absorbed and

concentrated directly into the network. Varieties such as white rot fungi and brown rot fungi, which produce powerful lignin peroxides and celluloses, are particularly efficient at such bioremediation.

Approaches to soil management, including problems of soil degradation and low soil fertility. Soilconstraints wereto be overcome by inputs: improved crop varieties, fertilizers, chemical control of pests and diseases and the use of irrigation. It had been demonstrated that crop yields could be raised by a factor of three to five times or more by the use of fertilizers, applied to the newly developed high-yielding crop varieties. Above all, large numbers of poor farmers simply cannot afford high levels of fertilizers and other purchased inputs, nor do they have the capital to take on the risk which these involve. Aspects of this new approach include:

- find ways of making the use of marginal lands sustainable; reclaim and restore degraded land
- improve germplasm to produce plant varieties which are adapted to soil constraints
- maintain soil organic matter and biological activity, with benefits both for soil physical conditions and balancednutrient supplies
- improve nutrient cycling and nutrient use efficiency in agro ecosystems
- use fertilizers and other external inputs at moderate levels, seeking strategic use to overcome deficiencies that cannot otherwise be remedied
- Improve water-use efficiency.

Agroforestry can contribute to all these aspects and has a major role to play in some. Tree litter and pruning's can substantially help to maintain soil organic matter and improve physical properties and at the same time supply nutrients. The contrast between natural and agricultural ecosystems suggests a high potential for agroforestry to lead to improved nutrient cycling and hence fertilizer use efficiency.

Trees Role in Improvement of Soils

Underlying all aspects of the role of agroforestry in maintenance of soil fertility is the fundamental proposition that trees improve soils.

1. The soil that develops under natural forest and woodland is fertile. It is well structured, has a good water-holding

capacity and has a store of nutrients bound up in the organic matter.

2. The cycles of carbon and nutrients under natural forest ecosystems are relatively closed, with much recycling and low inputs and outputs.

3. The practice of shifting cultivation demonstrated the power of trees to restore fertility lost during cropping.

4. Experience of reclamation forestry has demonstrated the power of trees to build up fertility on degraded land.

Nitrogen fixation and a high biomass production have been widely recognized as desirable. However, many properties are specific to particular objectives of systems in which the trees are used. Even species that are shunned for their competitive effects may have a role in certain designs. The properties which are likely to make a woody perennial suitable for soil fertility maintenance or improvement are:

- A high rate of production of leafy biomass and nitrogen fixation
- A dense network of fine roots, with a capacity for abundant mycorrhizal association.
- The existence of deep roots
- A high and balanced nutrient content in the foliage; litter of high quality (high in nitrogen, low in lignin and polyphones).
- An appreciable nutrient content in the root system.
- Either rapid litter decay, where nutrient release is desired, or a moderate rate of litter decay, where maintenance of a soil cover is required.
- Absence of toxic substances in the litter or root residues.
- For soil reclamation, a capacity to grow on poor soils.
- Absence of severe competitive effects with crops, particularly for water.
- Low invasiveness, Productive functions, or service functions other than soil improvement.

Effects of Trees on Soils

The capacity of trees to maintain or improve soils is shown by the high fertility status and closed nutrient cycling under natural forest, the restoration of fertility under forest fallow in shifting cultivation and the experience of reclamation forestry and agroforestry. Soil transects frequently show higher organic matter and better soil physical properties under trees. Some species, most notably Faidherbia abide, regularly give higher crop yields

beneath the tree canopy. Trees improve soil fertility by processes which:

- Increase additions to the soil, Reduce losses from the soil;
- Improve soil physical, chemical and biological conditions, Like Check runoff and soil erosion, maintain soil organic matter and physical properties, Increase nutrient inputs, through nitrogen fixation and uptake from deep soil horizons, Promote more closed nutrient cycling.

Trees may also adversely affect associated crops. The effects of allelopathy (inhibition effects) have probably been exaggerated by mistaking them for, or confounding them with, other processes. Competition for water is a serious but not insuperable problem in all dry environments, whereas competition for nutrients has rarely been demonstrated. Where the net effect of tree-crop interactions is positive, the length of the tree-crop interface, or extent of the ecological fields, should be maximized. If the net effect is negative, the aim of agroforestry system design should be to reduce the length of the interface. A range of properties have been identified which make tree species suited to soil improvement. For many purposes, high biomass production, nitrogen fixation, a combination of fine feeder roots with taproots and litter with high nutrient content are suitable. Tolerance to initially poor soil conditions is clearly needed for reclamation. About 100 species have been identified which are known to fulfill soil improving functions, but there is much scope to increase this range.

Recent Study

The soil-improving capacities of trees, and how these can be applied in practical agroforestry systems, continues to be a major focus of agroforestry. One important recent change of emphasis is that less attention is being given to hedger winter cropping (alley cropping), in view of the observed reluctance of farmers to adopt this system, whilst more emphasis is now placed on systems of managed tree fallows.

Kinds of Problem Soils

There are two types of problems.

Physical problems	Chemical Problems
Fluffy paddy soil	Acidic soils
Sandy soil	Salt affected soils –Saline soils
Subsoil hardening or hardpan	Sodic soils
Surface crusting	Saline-sodic soils
Water logged soil	
Peat and marshy soils	

Fluffy Paddy soils, Sandy soil, Hardpan soil, Surface crusting, Peat and Marshy Soil, Waterlogged Soil

Bioremediation through agroforestry

Tree species: *Eucalyptus robusta, Syzygium cumuni, Terminalia arjuna, Salix tetrasperma, Dalbergia latifolia, Eucalyptus camaldulensis, Eucalyptus grandis*

Grasses: *Brachiaria mutica, Dichanthium caricosum, Paspalum notatum, Brachiaria decumbens.*

Chemical Problem

1.Salt affected soils:

Halophytes are the native flora of saline soils. Few are suitable for reclamation. The basic principle of reclamation is the removal of excess salt to a desired level in root zone. Providing proper drainage, use of salt free irrigation water, acidic fertilizers, organic manures etc. are some of the mechanisms adopted. The process of Stalinization is accelerated by rapid evaporation from the surface. Leaching with water of good quality and adequate drainage of excess water from the soil is carried out. The selection of salt tolerant species is done which include suitable tree species such as *Prosopis juliflora, Tamarix articulate, Acacia nilotica* etc. Agricultural crops include barley, sugarbeet, cotton wheat, rice beans etc.

Bioremediation through Agroforestry

1. Promising woody species for saline soils are *Salvadora spp., Prosopis juliflora, Acacia nilotica, Parkinsonia aculeata, Butea monosperma, Terminalia arjuna, Salix spp*., D. sissoo and *Casurina equisetifolia*.

2. Highly salt tolerant and high biomass producing grass species include *Aeluropus lagopoides,*

Sporobolus helvolus, Cynodon dactylon and Brachiaria ramosa.

2. Sodic Soil

Bioremediation through Agroforestry

Prosopis juliflora and Karnal grass improves the soil condition to such an extent that after some time or years, less tolerant but more palatable fodder species such as- Berseem *(Trifolium alexandricum*) senji (*Melilotus parviflora*) and shaftal (*Trifolium resupinatum*) can be grownunder trees(Singh *et al*., 1993).

3. Saline and Sodic Soil

Bioremediation through Agroforestry

Acacia auriculiformis, Azadirachta indic a, Casurinaequisetifoia, Dalbergia sissoo, Alianthus excelsa, Prosopis cineraria, Acacia tortilis and A. nilotica tree species are used for bioremediation of the saline and sodic soils.

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BIOLOGICAL PLOUGH - PIGEONPEA IS A DROUGHT TOLERANT WONDER CROP

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Pigeonpea is one of the most important grain legume crops in the tropical and subtropical regions of the world. It ranks as the world's fifth most important pulse crop. India is the primary centre of origin and diversification for pigeonpea and occupies important place among grain legume grown in India. It is the main source of proteins for Indian vegetarians and is the second most important pulse crop of India. Pigeonpea is being cultivated in 42 l. ha at National level with a production of 38.9 l. t. In Tamil Nadu, it is being cultivated in 0.42 l. ha with a production of 0.44 l. t. The average productivity of India and Tamil Nadu are 919 and 1047 kg/ha, respectively. Despite the fact that a large number of high yielding varieties have been released, productivity of redgram remains stagnant at around 700 kg/ha as compared to its potential yield of 1500 to 3000 kg/ha. This gap is may be attributed to lower yield potential, cultivation in marginal lands, below average management efforts, non- availability of quality seeds, prevalence of higher temperature and various biotic and abiotic stresses.

Among the abiotic stresses, yield loss due to drought in Pigeonpea ranges from *20 to 50%.* Drought causes changes in plant water status, pigment content, osmotic adjustment and photosynthetic activity. Respiration, membrane stability index (MSI) and nutrient metabolism are also affected, ultimately reducing the plant growth. The damaging effects of drought include the enhanced generation of reactive oxygen species (ROS) that causes damage to the cellular components. To prevent this damage, the plant produces complex antioxidant systems, accumulate compatible solutes which can stabilize proteins and cellular structures and are capable of maintaining cell turgor and by these ways the plants try to protect themselves against drought.

However, Pigeonpea is consider as a drought tolerant crop with a large

variation for maturity period. As a result, it is widely adapted to a range of environments and cropping systems. Broadly, four maturity groups are recognized in Pigeonpea; extra early (90-120 days), early (120-150 days), medium (150-200 days) and late (200-300 days). These variations for maturity have direct relevance on the survival and fitness of the crop in different agro-ecological niches. Even-though it is a drought tolerant legume on account of its deep root system extra early and early types complete their life cycle just after recession of the monsoon season. However, their reproductive phase is more often encounters terminal drought. Medium and long duration Pigeonpea is focused acute soil moisture deficit in absence of any supplementary irrigation during their flowering and pod filling stages.

Pigeonpea appeared to rely primarily on dehydration tolerance and maintained high tissue water status for longer because of significant more total dry matter (TDM) in roots. Drought resistant genotypes can avoid moisture stress through faster root growth. The effect of moisture stress imposed at pre-flowering stage has been associated with greatest reductions in nodule nitogenese activity (70-90%), followed by the rate of photosynthesis (50-71%) and root and nodule respiration (31-45%). Large seeds cultivars have been observed more sensitive than small seeded ones. Among small seeded cultivars with indeterminate growth habit have been found more drought resistant than that determinate type. Values for relative water content (RWC) and water retention in leaves were also higher in cultivars with indeterminate growth. In early duration pigeonpea, the maintenance of both leaf area index (LAI) and fractional canopy light interception appears to indicate genotypic drought tolerance. Osmotic adjustment (OA) is considered as an important physiological mechanism of drought adaptation in many crop plants. Pigeonpea has high OA and high dehydration tolerance compared to other crops. Relative water content (RWC) parameter could be used to select high yielding genotypes that maintain cell turgor under water deficit environment hence it is a good indicator of drought tolerance while breeding for drought resistance in Pigeonpea. Enhanced proline accumulation during stress indicated that proline plays a cardinal role as an osmoregulatory solute in plants. The increased activities of antioxidant enzymes including

superoxide dismutase(SOD) and peroxidase (POD) indicated that an effective antioxidant defense mechanism protects pigeonpea from destructive oxidative reactions.

Even though, exploiting the genetic potential is the only alternative for yield stability under water stress environment by understanding the physiological and biochemical processes associated with drought tolerance. Therefore, improved pigeonpea genotypes with better water use efficiency and high yield will be suitable for cultivation in drought prone areas and would help to improve the economic status of poor farmers. The feasibility of realizing the desired improvement largely depends on the amount of trait variability present in the germplasm for identification and utilization of tolerant or resistant parents in a breeding program. Screening of Pigeonpea varieties for high reproductive fitness under actual water deficit condition may be realistic approach. The varieties *viz*., LRG 30, ICPL 85063, ICPL 332 is the most suitable varieties. The varieties yielded high yield under moisture deficit might be due to their high RWC, more no. of pods per plant and harvest index. Drought stress caused an increase in the free amino acid and glycine betaine (GB) content.

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CONSEQUENCES AND RESOLUTIONS OF SOIL POLLUTION

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ABSTRACT

Soil pollution is caused by the presence of human-made chemicals or other alteration in the natural soil environment. Soil contamination can be termed as unfavourable alteration of soil by addition or removal of substances and factors which decrease soil productivity, quality of plants and ground water. soil pollution is caused by (i) pesticides, herbicides, and fumigants (ii) chemical fertilizers and (iii) air pollutants washed down from atmosphere through rain. It reduces soil fertility, nitrogen fixation, increases erodibility, Imbalance in soil fauna and flora, ecological imbalance, release of pollutant gases, increased salinity, clogging of drains, public health problems, pollution of drinking water sources, the pollutants will change the makeup of the soil and the types of microorganisms that will live in it. soil pollution can be cured by recycling, reforesting and solid waste management.

Keywords: Soil pollution, Pesticides, Ecological Imbalance, Reforesting, Recycling

INTRODUCTION

Pollution occurs when pollutants from various sources contaminate our natural surroundings these pollutants are the key elements of pollution which are found as waste material of different forms. It is this pollution which brings imbalance in our surroundings and ecosystem which is our biggest life support system. The modernization and development which were earlier considered as boon to the modern society has turned into permanent ailment for the modern man. Along with development, pollution has also permanently settled into our lives, brought with it global warming.

Every form of pollution has two sources of occurrence; the point and the non-point sources. It is easy to identify, monitor and control the point source, whereas, the non-point sources are always hard to control.

I. SOIL POLLUTION

Soil pollution is caused by the presence of xenobiotic (human-made)

chemicals or other alteration in the natural soil environment. Soil contamination can be termed as unfavourable alteration of soil by addition or removal of substances and factors which decrease soil productivity, quality of plants and ground water.

It is typically caused by various industrial activities, chemicals used in agricultural activities, or improper disposal of waste material. The most common and hazardous chemicals which are used are petroleum hydrocarbons, polynuclear aromatic hydrocarbons (such as naphthalene and benzo (a) (Pyrene), solvents, pesticides, lead and other heavy metals. Contamination is correlated with the degree to which industrialization takes place and the intensity to which chemicals are used. It is mainly of two main types; negative and positive.

Negative Soil Pollution: Negative soil pollution includes over usage of soil. Water and air are the two factors responsible for erosion of soil. Water erosion takes place near the hills where high speed rivulets and flood removes and washes away the top soil. High speed winds also become a source of soil erosion also occurs by high-speed winds which brings sand particles from dry desert. Fertile land is also being converted into barren areas by unplanned urbanization, building of road, houses or industrial complexes. Rubbish, empty cans, garbage, broken furniture, empty bottles, building material, sludge, ash, etc. are all dumped outside the towns on vacant lands which not only become barren but also make the nearby lands so. It is sometimes also called third pollution or landscape pollution.

Positive Soil Pollution: It is pollution caused by (i) pesticides, herbicides, and fumigants (ii) chemical fertilizers and (iii) Air pollutants washed down from atmosphere through rain.

Agricultural Practices

Modern agricultural practices pollute the soil to a large extent. With the advancing agro-technology, huge quantities of fertilizers, pesticides, herbicides and weedicides are added to increase the crop yield.

Pesticides and Weedicides: A number of chemicals have been developed to kill insects (insecticides), fungi (fungicides), algal blooms (algaecides), rodents (rodenticides), weeds (weedicides or herbicides) in order to improve agriculture, forestry, horticulture and

water reservoirs. The most widely used among them are insecticides. Most of these insecticides or pesticides are broad-spectrum and affect other animals, man and even plants. They are, hence, also called biocides.

(i) Chlorinated Hydrocarbons

They include DDT (dichloro-diphenyl-trichloroethane), DDE, Chlordane, Aldrin, Dieldrin, Endrin, Heptachlor, BHC (benzene hexa-chloride), etc. Chlorinated hydrocarbons are toxic. Dieldrin is 5 times more toxic than DDT when ingested and 40 times more poisonous when absorbed. Endrin is the most toxic amongst chlorinated hydrocarbons. Besides, being toxic these pesticides are both, persistent and mobile in the ecosystem (over dust particles- in air, over organic matter in water). The chlorinated hydrocarbons are fat soluble and tend, to accumulate inside living organisms.

Their concentration per unit weight of the organisms also rises with rise in tropic level due to the phenomenon of biological amplification. DDT and other chlorinated hydrocarbons affect central nervous system, cause softening of brain, cerebral haemorrhage, Cirrhosis of liver, hypertension, cancer, thinning of egg shells in birds, malformation of sex hormones, etc. Ecological amplification of chlorohydrocarbons, therefore, proves, fatal to higher trophic level animals, especially fish and birds. Excessive spray of hard biocides sometimes causes an imbalance in prey-predator population.

(ii) Organo-Pesticides

They include organo-phosphorus compounds (e.g., Malathion, parathion, diazonin, triothin, ethion, tetraethyl pyrophosphate or TEPP) and carbamates. Organo- pesticides are degradable but being poisonous they influence the workers handling them causing sweating, salivation, nausea, vomiting, diarrhoea and muscular tremors.

(iii) Inorganic Pesticides

The pesticides usually contain arsenic and sulphur. Their continued use is poisonous to both plants and animal life since the pesticides are of persistent nature.

(iv) Weedicides (Herbicides)

The chemicals are used in clearing area of forests for building new residential or industrial colonies, highways, rail-road, weed control in agriculture, horticulture and in forest management. The weedicides or herbicides are usually

metabolic inhibitors which stop photosynthesis and other metabolic activities and hence kill the plants. Some weedicides cause death due to proliferation of phloem cells so as to block transport of organic food.

II. URBAN WASTES

Urban wastes comprise of both commercial and domestic wastes consisting of dried sludge and sewage. All the urban solid wastes are commonly referred to as refuse. Constituents of urban refuse: This refuse consists of garbage and rubbish materials like plastics, glasses, metallic cans, fibres, paper, rubbers, street sweepings, fuel residues, leaves, containers, abandoned vehicles and other discarded manufactured products. Urban domestic wastes though disposed of separately from industrial wastes, can still be dangerous. This happens because they are not easily degraded.

III. INDUSTRIAL WASTES

Disposal of Industrial wastes is the major problem for soil pollution Sources: Industrial pollutants are mainly discharged from various origins such as pulp and paper mills, chemical fertilizers, oil refineries, sugar factories, tanneries, textiles, steel, distilleries, fertilizers, pesticides, coal and mineral mining industries, drugs, glass, cement, petroleum and engineering industries etc.

Effect: These pollutants affect and alter the chemical and biological properties of soil. As a result, hazardous chemicals can enter into human food chain from the soil or water, disturb the biochemical process and finally lead to serious effects on living organisms.

IV. RADIOACTIVE POLLUTANTS

Radioactive substances resulting from explosions of nuclear testing laboratories and industries giving rise to nuclear dust radioactive wastes penetrate the soil and accumulate giving rise to land/soil pollution.

Ex: Radio nuclides of Radium, Thorium, Uranium, isotopes of Potassium (K-40) and Carbon (C-14) are commonly found in soil, rock, water and air. Explosion of hydrogen weapons and cosmic radiations include neutron, proton reactions by which Nitrogen (N-15) produces C-14. This C-14 participates in Carbon metabolism of plants which is then into animals and human beings. Radioactive waste contains several radio nuclides such as Strontium90, Iodine-129, Cesium-137 and isotopes of Iron which are most injurious. Strontium get deposited in bones and

tissues instead of calcium. Nuclear reactors produce waste containing Ruthenium-106, Iodine-131, Barium-140, Cesium-144 and Lanthanum-140 along with primary nuclides Sr-90 with a half-life 28 years and Cs-137 with a half-life 30 years. Rain water carries Sr-90 and Cs-137 to be deposited on the soil where they are held firmly with the soil particles by electrostatic forces. All the radio nuclides deposited on the soil emit gamma radiations.

V. FERTILIZERS

Chemical fertilizers added to the soils enter the crop plants as well as leach down into water table to become part of underground water. Nitrogen fertilization produces toxic concentration of nitrate or nitrite in the leaves and fruits, e.g., Spinach, Mustard, and Lettuce. Nitrate containing canned food causes corrosion of tin lining of the can, increases tin content of food and produces nitrous oxide (N_2O) gas. The toxicity increases if the drinking water also possesses sufficient nitrates. In the alimentary canal, the activity of bacteria changes nitrates into nitrites. The latter enter the blood and combine with haemoglobin to form methaeinoglobin. As a result, oxygen transport is reduced. It gives rise to disease known as methaemoglobinaemia (presence of methaemoglobin in the circulating blood). In infants-it produces cyanosis, (blue babies due to bluish tint of skin). In adults it produces breathlessness. In infant's nitrate poisoning can be fatal unless and until methylene blue is injected in time. Excessive use of chemical fertilizers causes soil deterioration through the decrease in natural bacterial population (nitrogen fixing, nitrifying, and sulphofying) and destruction of crumb structure. The Salt content of the soil is also bound to increase with continuous' use of fertilizers.

EFFECTS OF SOIL POLLUTION

- Reduced soil fertility, pollution runs off into rivers and kills the fish, plants and other aquatic life
- Reduced nitrogen fixation, Increased erodibility, larger loss of soil and nutrients
- Deposition of silt in tanks and reservoirs, Reduced crop yield
- Imbalance in soil fauna and flora, polluted soil may no longer grow crops and fodder
- Soil structure is damaged (clay ionic structure impaired)
- Corrosion of foundations and pipelines, create toxic dusts,

impairs soil stability, may release vapors and hydrocarbon into buildings and cellars

Industrial

- Dangerous chemicals entering underground water
- Ecological imbalance, Release of pollutant gases, radioactive rays causing health problems
- Increased salinity, reduced vegetation

Urban

- Clogging of drains, Inundation of areas, public health problems, Pollution of drinking water sources, Foul smell and release of gases, Waste management problems

CONTROL OF SOIL POLLUTION

Reusing of materials

Materials such as glass containers, plastic bags, paper, cloth etc. can be reused at domestic levels rather than being disposed, reducing solid waste pollution.

Recycling and recovery of materials

This is a reasonable solution for reducing soil pollution. Materials such as paper, some kinds of plastics and glass can and are being recycled. This decreases the volume of refuse and helps in the conservation of natural resources. For example, recovery of one tonne of paper can save 17 trees.

Reforesting

Control of land loss and soil erosion can be attempted through restoring forest and grass cover to check wastelands, soil erosion and floods. Crop rotation or mixed cropping can improve the fertility of the land.

Solid waste treatment

Proper methods should be adopted for management of solid waste disposal. Industrial wastes can be treated physically, chemically and biologically until they are less hazardous. Acidic and alkaline wastes should be first neutralized; the insoluble material if biodegradable should be allowed to degrade under controlled conditions before being disposed.

Improvement in mining techniques and transport of extracted materials should be done extensively, so that spread of mine dust should be minimised. The area should not be left barren and dry. Instead, afforestation should be carried out as soon as it becomes feasible. As a last resort, new areas for storage of hazardous waste should be investigated such as deep well injection and more secure landfills. Burying the waste in locations situated away from residential areas is the

simplest and most widely used technique of solid waste management. Environmental and aesthetic considerations must be taken into consideration before selecting the dumping sites. Incineration of other wastes is expensive and leaves a huge residue and adds to air pollution.

Pyrolysis is a process of combustion in absence of oxygen or the material burnt under controlled atmosphere of oxygen. It is an alternative to incineration. The gas and liquid thus obtained can be used as fuels. Pyrolysis of carbonaceous wastes like firewood, coconut, palm waste, corn combs, cashew shell, rice husk paddy straw and saw dust, yields charcoal along with products like tar, methyl alcohol, acetic acid, acetone and a fuel gas.

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CULTIVATION OF MICROALGAE - AS BIOLOGICAL SOURCES OF LIPIDS AND HYDROCARBONS

Article ID: AG-V02-I04-04

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Introduction

Microalgae or microphytes are microscopic algae, typically found in freshwater and marine systems, living in both the water column and sediment. They are unicellular organisms, existing individually, or in chains or in groups. They are tiny reservoirs of biofuels with lipid and carbohydrate contents called as third generation biofuels (Dickinson *et al*., 2017).

Characteristics of Microalgae

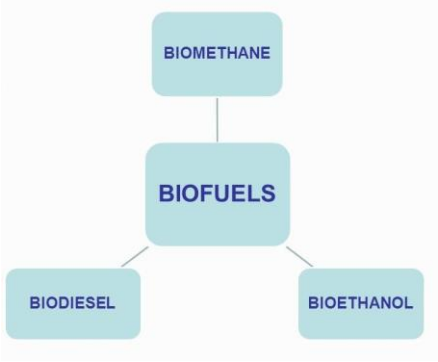
- Rapid growth rates & population densities
- Can double its biomass in < 24 hours
- Harvesting cycles: 1-10 days
- Less complex structure
- Higher oil content
- Produces lipids, carbohydrates and proteins
- Algal biofuel is non-toxic
- Algal biofuel is highly bio-degradable

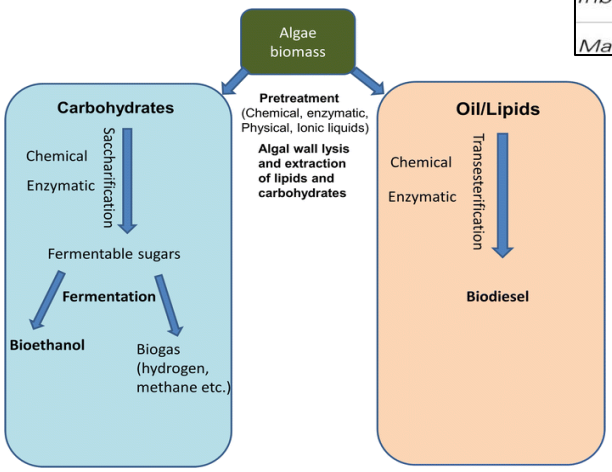
Plant Sources	Seed oil content (% oil by wt in biomass)	Oil yield (L oil/ ha year)	Land use (m^2 year/ kg biodiesel)
Microalgae (low oil content)	30	58,700	0.2
Microalgae (medium oil content)	50	97,800	0.1
Microalgae (high oil content)	70	136,900	0.1

Desirable characteristics of fuel sources	Petroleum	Crop	Microalgae
Low sulfur content		✔	✔
Sequesters CO_2		✔	✔
Higher lipid productivity			✔
Lower freshwater needs			✔
No competition with food sources	✔		✔
Can be obtained from arid land	✔		✔

Conversion of Algae to Biofuels

- Chemical process includes transesterification. E.g., Biodiesel
- Thermochemical processes include liquefication, hydrogenation, pyrolysis and gasification. E.g., Bio-oil and gas
- Biochemical processes. E.g., Bioethanol, Biomethane





Lipid and starch production

- Biodiesel is typically made up of fatty acid methyl ester (FAME) and sometimes fatty acid ethyl ester (FAEE) molecules, which have an approximate molar mass of 290 g/mol.
- Lipid precursors are stored in lipid bodies in the cytoplasm and chloroplast.
- If biodiesel is desired, strains with higher lipid productivity are preferred.
- If the desired product is ethanol, a strain with a high starch concentration is ideal.

Microalgae species	Biomass productivity (g/L/day)	Lipid content (% dry weight biomass)	Lipid productivity (mg/L/day)
Ankistrodesmus falcatus	0.34	16.49	56.07
Ankistrodesmus fusiformis	0.24	20.66	49.58
Botryococcus braunii	0.25	44.97	112.43
Botryococcus terribilis	0.20	49.00	98.00
Chlamydomonas reinhardtii	0.24	22.10	
Chlamydomonas sp.	0.24	15.07	36.17
Chlorella vulgaris	0.73	28.07	204.91
Dunaliella tertiolecta	**0.098–0.12**	**16.7–71.0**	
Monoraphidium contortum	0.307	22.20	
***Nannochloropsis* sp.**	**0.17–1.43**	**12.0–53.0**	**37.6–90.0**
Scenedesmus obliquus	0.16	16.73	26.77
Tribonema minus	0.170	50.23	

Marine microalgae strains are indicated by bold text.

Table 2: The biomass and lipid productivity of different microalgae

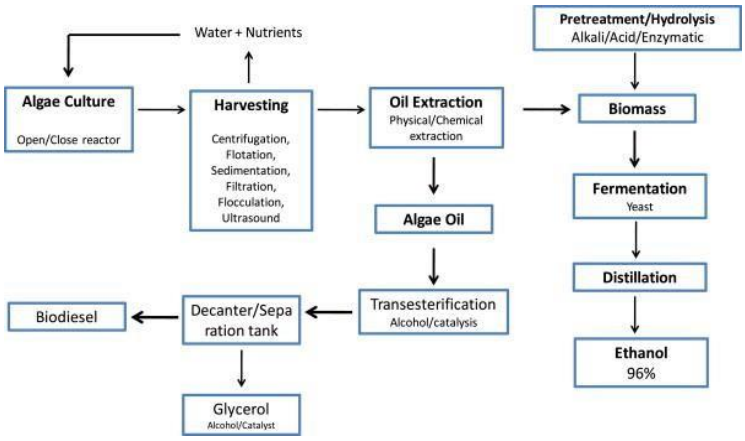
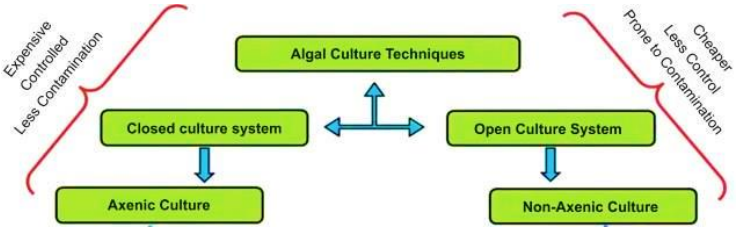


Fig. 1: Flow chart for the production of biodiesel from microalgae culture

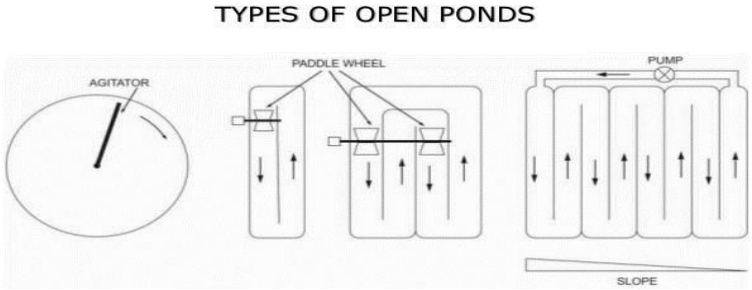
Cultivation techniques

There are two main types of culturing systems: open ponds and closed PBRs (Tredici, 2004).



Open systems

The most common type of open, outdoor cultivation system. They are usually circular to oval in shape and with closed-loop recirculating passages encased with plastic or concrete. Carbon dioxide gas is often flared up from the pond's bottom to provide carbon. To prevent sedimentation, agitaion is done using paddlewheels.



Circular pon Raceway pond Unstirred Pond

Closed systems: Photobioreactors (PBRs)

There are elevated risks associated with closed systems including biofilm formation, oxygen accumulation and overheating. Different types of PBRs are given below.

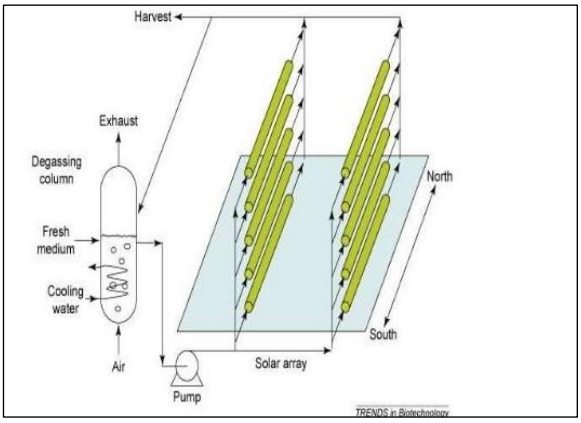


Fig. 2: Tubular photobioreactor

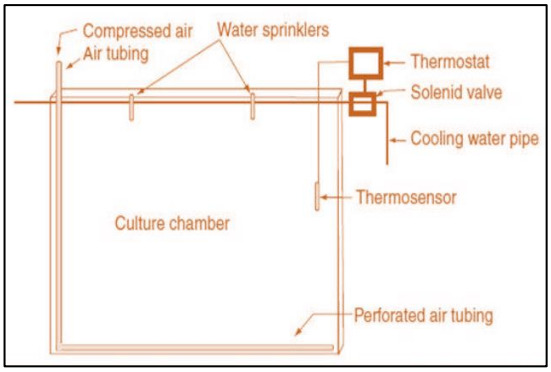


Fig. 3: Flat panel photobioreactor

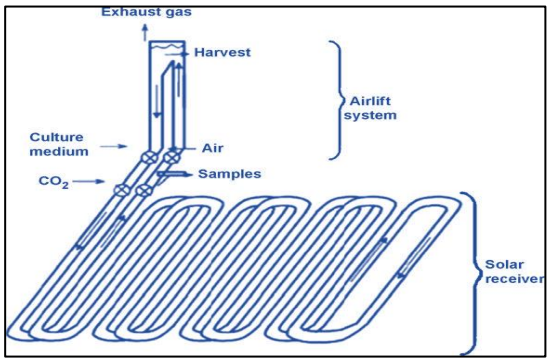


Fig. 4: Helical

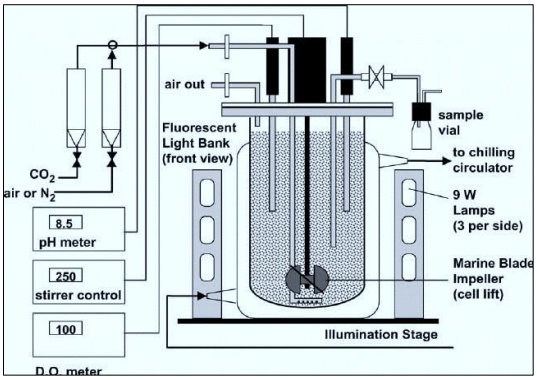


Fig. 5: Stirred photobioreactor

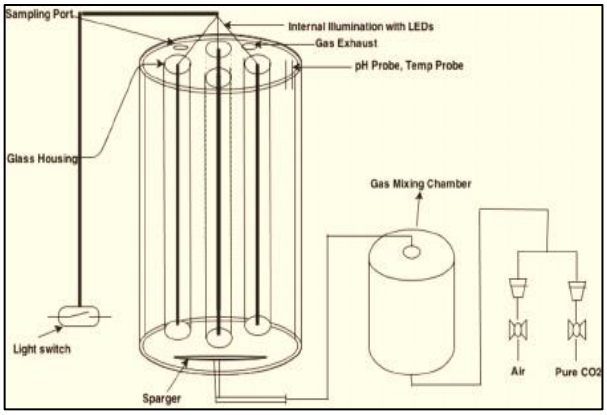


Fig. 6: Airlift photobioreactor

Harvesting

Harvesting method	Description
Centrifugation	Use of centrifugal force to sediment microalgae
Flotation	Use of microbubbles to carry microalgae to the surface. Microbubbles are produced via dissolved air flotation (DAF), electrolytic flotation, or dispersed air flotation (DiAF)
Filtration	Biomass filtered through pores membrane filtration includes Ultrafiltration - 0.02 to 0.2 µm microfiltration - 0.1 to 10 µm. For most microalgae strains, it has been shown that a pore size of 0.1–0.5 µm is preferable
Flocculation	Substance is added to the culture to sediment the cells metal salts, polymers, or biopolymers are used to form flocs. Two biopolymers with potential are chitosan and cationic starch

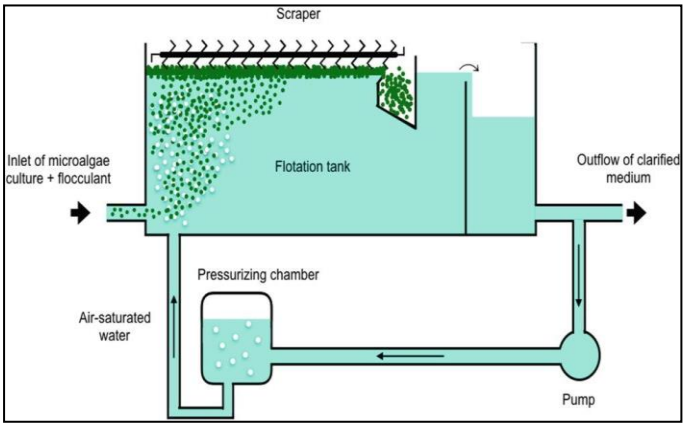


Fig. 7: Flotation

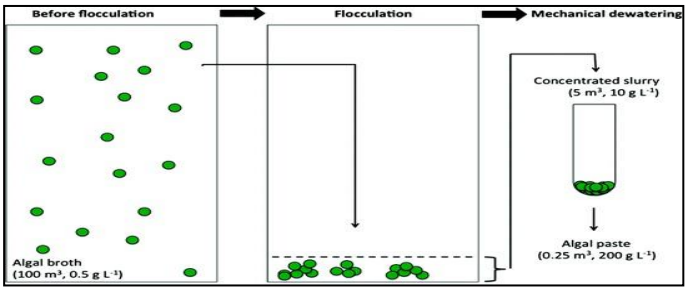


Fig. 8: Flocculation

Fig. 9: Centrifugation

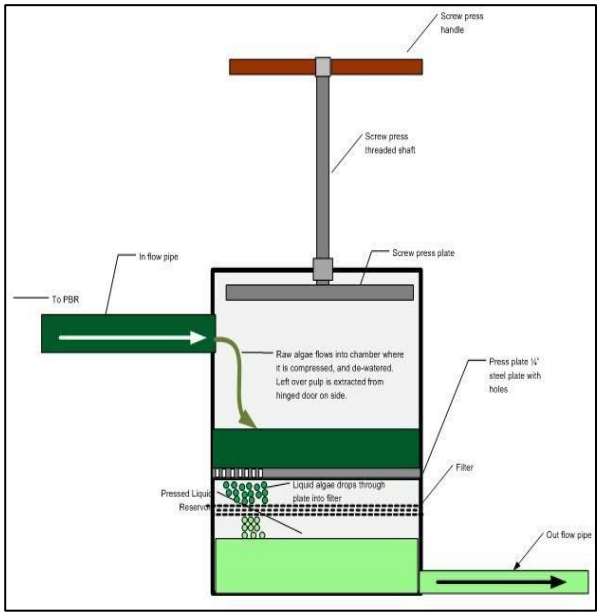


Fig. 10: Filtration

Pretreatment (Al hattab and Ghaly, 2015)

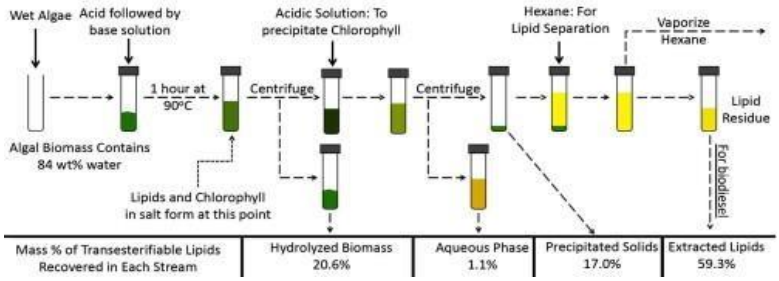
Pretreatment method	Description
High-pressure homogenization	High pressure produces heat during the process makes the cell wall softer so it is easier to lyse cells by shear forces
Bead milling	Culture is mixed with beads made of quartz or metal and the container is shaken. The cells lyse due to the friction and shear forces caused by the collisions with the beads.
Enzymatic lysis	Enzymes such as lipase, trypsin, cellulase, neutrase, papain and pectinase degrade parts of the cell wall
Electroporation	An electric current disrupts the cell membrane of microgae

Drying

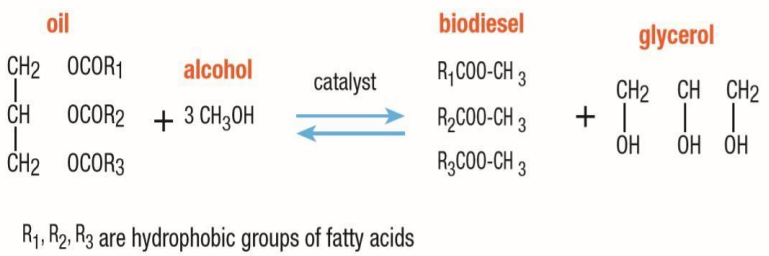
- **Freeze-drying: Freeze-drying** is a process where microalgae are freezed at a temperature and pressure below the triple point of water followed by vacuum drying to induce sublimation.
- **Oven drying:** Drying by subjecting the biomass to about 60 °C for 3 h in large ovens.
- **Spray drying:** Passing of hot air over biomass droplets that are sprayed through a nozzle.

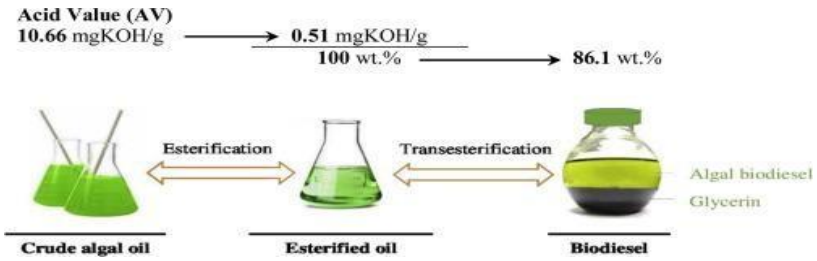
Lipid extraction

For biodiesel production microalgae contain polar lipids (e.g., phospholipids and glycolipids) and neutral lipids (e.g., tri, di- and monoacylglycerols) are selected. The obtained lipids are transesterified using alcohol and catalyst to form biodiesel and glycerol.



Transesterification

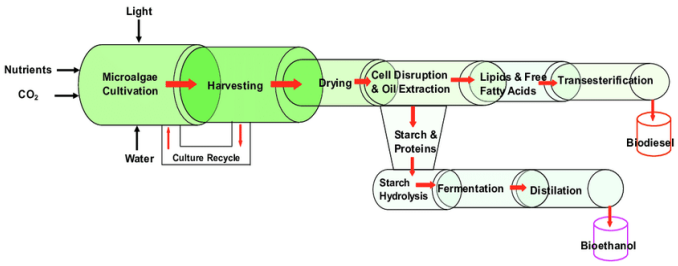




process of converting wet algal biomass into bio-oil or biocrude-oil under moderate temperature and high pressure.

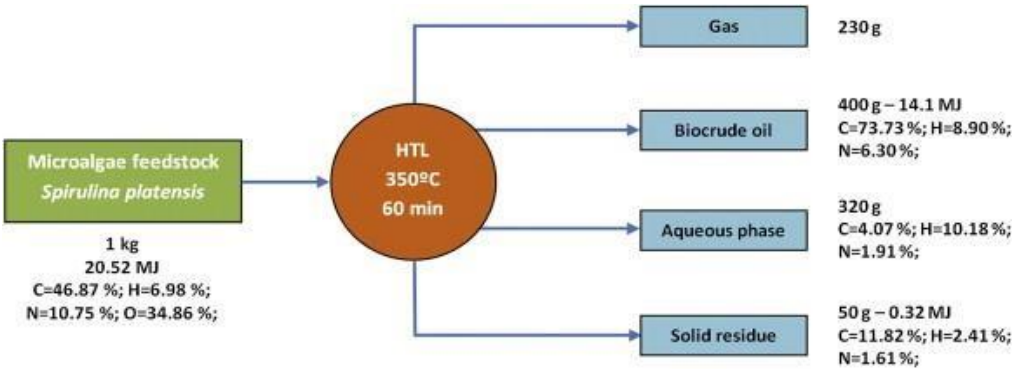
Bioethanol

- Microalgae biomass waste with high starch/cellulose content after oil extraction can behydrolyzed to obtain sugary syrup for ethanol production.
- Among most of the microalgae species, *Porphyridium cruentum* was shown to have high ethanol production due to its capacity for accumulating large amount of carbohydrates (22.8-39.3 % dry weight biomass).



Bio-Oil

Hydrothermal liquefaction (HTL) is the method followed for obtaining bio-oil. It is a thermal depolymerization



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Volume: 02 Issue No: 04

ENRICHMENT OF SOIL EMINENCE BY PULSES FARMING

Article ID: AG-V02-I04-05

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Introduction

Soil is the backbone of all life on earth. Soil not only provides a place for food to grow, but is also the basis of the food web that is necessary for plant health. It stores and releases the essential nutrients and minerals a plant needs to be healthy, to grow and produce their flowers, seeds, fruit or vegetables. Erosion, compaction, nutrient imbalance, pollution, acidification, water logging, loss of soil biodiversity and increasing salinity, overgrazing, unsustainable agricultural practices and climate changes have been affecting soil across the globe, reducing its ability to grow crops. Soil management practices are considered as the most vital and sustainable possible solution to protect soil health. The consideration is increasing and soil quality enrichment has come to the scenario. In this situation, pulse-inclusive production system can be strategic method to take care of soil health.

Pulses are an important commodity group of crops that provide high quality protein complementing cereal proteins for pre-dominantly substantial vegetarian population of the country. India is the largest producer, 26% of world's production, and consumer, 30% of total pulses of the world. Bengal gram (desi chana), red gram, green gram, chick peas (kabulichana), Blackgram, Red kidney beans (rajma), black eyed peas (lobiya), lentils (masoor), whitepeas (matar) are major pulses grown and consumed in India.The major pulse producing states in the country are Madhya Pradesh, Maharashtra, Uttar Pradesh, Andhra Pradesh, Karnataka, Jharkhand Rajasthan and Telangana. Pulses having beneficial effects on soil biological, chemical and physical conditions are absolutely recognized and valued as "soil building" crops. Soil health can be improved by intensive pulse cultivation.

Importance of Pulses in Soil Health Management

- Legumes improve soil fertility through the symbiotic association with microorganisms (nitrogen fixing soil bacteria), such as rhizobiawhich fix the atmospheric nitrogen, convert into useful ammonia or nitratesand make nitrogen available to the host and other crops by a process known as biological nitrogen fixation (BNF) there by improve soil productiveness and reduce dependence on energy-intensive fertilizers. Pulses produce about 21 million tons of nitrogen per year.
- Pulses also help in efficient use of soil phosphorus by breaking down the insoluble phosphates in soil. Since phosphorus represents an expensive and limiting resource in several cropping systems, recycling and recovering of soil phosphorus in available forms could be a great achievement on improving soil health (Yuvaraj et *al.* 2020).
- Pulses are mostly cultivated under rainfed conditions and do not require intensive irrigation facility and are often considered under drought tolerant crops. Pulses are well known to increase the water use efficiency of the entire cropping system. Highly water efficient pulses like lentil, chickpea, green gram and black gram are effectively grown in drought prone areas and improve soil fertility by fixing nitrogen. Pulse dominating cropping system releases less amount of CO2 in the atmosphere as compared to any cereal-based cultivation practices. Plentiful use of pulse crops can lower the average carbon foot print (Kinjal Mondal *et al*., 2021).
- Pulse crops often release organic acids which mobilize unavailable soil nutrients like Ca, K, P, Fe and enrich soil profile. Due to low C/N ratios, pulse residues degrade promptly and soil fertility is improved with sufficient amount of nutrients (Stagnari *et al.* 2017).
- Pulses remediating soil from poisonous metal and organic pollutants through enhancing C-sequestration in the soil by facilitating rapid decomposition

of C-rich crop residues in the soil and their conversion into soil organic carbon (Kumar and Yadav 2018). As cover crops, pulses effectively control soil erosion andsupport aenormous as well as diversified microbial population and therefore promote biodiversity in soil.

Conclusion

Pulses are packed with protein, fibre, antioxidants, vitamins and minerals, they emit small amounts of greenhouse gases, sequester carbon, enrich the soil with nitrogen and control weeds within crop rotation. The cultivation of nitrogen-fixing pulses for restoring soil fertility and soil quality are the foundation of most biological systems. The potential of pulses would help address future global food security, nutrition and environmental sustainabilityand also to attain the sustainable development goals in the changing climatic scenario.

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GENETICS OF MULBERRY SILKWORM

Article ID: AG-V02-I04-06

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Introduction

The silkworm *Bombyx mori* has attracted great attention from geneticists from all over the world since it is as ideal animal (next only to Drosophila) for experimental study in genetic science in view of the great number of heritable characteristics in the egg, larval, pupal and adult stages and the comparatively short life cycle which enables four to six generations to be bred in a year.

Chromosome Number

- *Bombyx mori* (n = 28)
- *Bombyx mandarina* (n = 27)

Sex limited characters in silkworm (egg and larva)

It refers to the "Characters which are observed or seen in any one sex or restricted to that sex that may be only in male or female". By observing the sex-limited characters in egg, larva, cocoon, we can separate the males and females easily.

In the silkworm *Bombyx mori,* female is the heterogametic sex (ZW) and male is the homogametic sex (ZZ). W - chromosome has been found to be strongly female determining and has been successfully applied to produce different genetic stock with the translocated W – Chromosome carrying dominant autosomal alleles for egg

colour, larval marking and cocoon colour. Such translocated W-chromosomes express the autosomal dominant genes only in females, thus allowing discrimination of sex at egg or larval or cocoon stages depending on the translocated stocks. Such 'sex limited' stocks have been put to commercial use in sericulture.

E.g., Sex limited races:

Cocoon - CSR 2 (SL), CSR 8 (SL)

Larva - CSR 18 (SL), CSR 19 (SL)

Advantages of sex – limited characters in silkworm

- Utilization of sex-limited silkworm breeds will facilitate in sex separation while preparation of F1 hybrids in commercial grainages.
- Selfing can be completely avoided by using sex-limited silkworm breeds.
- Efficiency of sex-determination can be improved through differentiation of cocoon colour with less labour requirements.
- Choice can be made to rear only male silkworms for commercial rearing as the ratio of silk to body weight as well as evenness of the silk filament are better in males. Male cocoons can be sent for reeling fetching better price.
- Silkworm breeds with sex-limited cocoon colour which makes egg production technology easier and allows an opportunity to conduct sex-separated rearings.

Conclusion

Knowing the basic genetics of silkworm helps to find new races or varieties of species which would bring higher yield enhances the livelihood of farmers eventually.

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IMPORTANT FACTORS FOR SUCCESSFUL REPRODUCTION IN SHEEP AND GOAT

Article ID: AG-V02-I04-07

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Introduction

The success of sheep and goat production is equal to reproduction. Productivity and profitability are measured by ovulation rate, conception rate, the number of kids or lambs born, the number of kids or lambs weaned and the frequency in which they are produced. Reproductive efficiency is one of the most important economic traits in livestock production. Maintaining good reproductive functions in the flock is a pivotal role in the success of any livestock production system.

Although reproductive traits in sheep have low heritability, the genetic quality of a sheep and goat flock is important. More ever, improving the reproductive efficiency of a sheep and goat flock by genetic selection is slow and difficult. Table 1 shows reproductive efficiency in sheep through genetic selection.

Table 1. Heritability Estimates for Reproductive Traits in Sheep

S. No	Trait	Heritability (Percent)
1	Ewe fertility	5
2	Prolificacy[a]	10
3	Scrotal circumference	35
4	Age at puberty	25
5	Lamb survival	5
6	Ewe productivity [b]	20

[a]Lambs born/ewe/lambing[b] Body weight of lamb(kg) weaned/ ewe
Source: ASIS, 2002.

Reproductive traits are influenced by the environment as well as a few other important factors such as weather, season, age and nutrition. Hence, these factors need to be focused on to bring

out the desirable result in sheep and goat production (Gimenez, 2007).

Weather

Weather is defined as the state of the atmosphere at a particular place and time. It is influenced by heat, cloudiness, dryness, sunshine, wind, rain, etc.

Temperature and Humidity

Sheep are more susceptible to high temperatures and humidity than goats. Stress caused by the high environmental temperature can seriously affect fertility, survival of the embryo and development of the foetus. High humidity increases the risk of heat stress at any kind of air temperature.

A rise in body temperature causes reproductive problems. Increased body temperatures occur most commonly due to high environmental temperatures but can also be the result of disease, fever, or any other factor that influences an increase in body temperature.

Effect in ewes and does

If a ewe or doe cannot maintain normal body temperature, ovulation and conception rates decrease and the embryo is less likely to survive when conception does occur. The most critical period for conception and embryo survival in the ewe and doe is the first 21 to 30 days after breeding (Gimenez, 2007).

Effect in rams and bucks

Fertility in rams and bucks is also affected by temperature and humidity as with ewes and does. Heat stress produced by environmental conditions or fever caused by diseases significantly elevates body temperature for an extended period that can interfere with sperm production and development thus in turn affecting semen quality. The fertility of rams and bucks will get affected within a few days of exposure to extreme heat and it can take a minimum of 6 to 10 weeks before sperm quality returns to normal.

Shearing the flock of ewes and rams 2 to 4 weeks before breeding can help to reduce heat stress. Extreme cold temperatures can be also harmful, especially during cold weather with high wind and excess chillness. These extreme conditions can freeze the scrotum and even the testicles. Stresses out of sickness can also slow down or stop sperm production temporarily (Gimenez, 2007).

Heat stress influences occurrences of oestrous and the production of embryos. Heat stressed ewes produce generally lower birth weight lambs than the unstressed animals. It is because heat stress may cause a temporal impairment of placental size and function causing a transient reduction in foetal growth rate. It also alters the secretion of the hormones regulating reproductive tract function (Naqvi *et al,* 2012).

Age

Age at puberty has a marked effect on lifetime production. It is influenced by genetics and the environment in sheep and goats. Further, the breed and size of the animal at maturity create considerable variations the first time breeding in sheep and goats (Gimenez, 2007).

In most cases, ewes reach puberty around 12 months of age (Jakes and Anderson, 2008). However, Sheep normally attain full growth at the age of 2 years and this may vary from 18 months to 3 years depending on the breeds and localities. Other influences on puberty include feeding and breeding. Overfeeding and/or underfeeding the lamb at pre-weaning and post-weaning can delay the onset of puberty. Furthermore, wool sheep (ewes) usually reach maturity at a later age than meat sheep. The fibre breeds are commonly known to mature later. Overfeeding ewe lambs before reaching their puberty at 2 to 4 months has a detrimental effect on mammary development because they deposit excess fat in their udders, which affects subsequent milk-producing ability (Gimenez, 2007).

Ewes of age 18-24 months are generally used for mating. Breeding too young ewes result in more weaklings and higher lamb mortality. The rams are mature at 1 year of age but it is desirable to use rams for mating from age 2 ½ years to 7 years of age (Banerjee, 1998).

The genetic makeup of the animal also determines when puberty occurs in the female. The doe can reach puberty between 4 and 12 months of age, depending on the breed, the season of birth, level of nutrition/ feeding and overall health status. However, like the ewe, overfeeding or underfeeding the doe can hinder puberty as well as her reproductive performance. Under-feeding can lower the chances of conception and a lack of adequate nutrition will subsequently hinder

lactation. Puberty is reached when the female exhibits her first heat (oestrus) and ovulation (USDA, 2019).

In India, usually, a doe attains sexual maturity between 15 to 18 months of age but this period can be reduced by 3 to 5 months by proper feeding and care. As a result, most does will attain sexual maturity at one year of age (Prasad, 1996).

Nutrition

The nutritional status of a flock is the most important factor influencing reproduction. It is also the factor over which the farmer has the most control either by increasing or reducing nutrient consumption. According to Gimenez (2007), the body condition of a ewe or doe strongly affects the following four aspects as

a. The time at which puberty attains
b. Conception rate at first estrus in ewe lambs and doelings
c. The length of the postpartum interval
d. The health and vigour of new-born lambs and kids

Any changes in body condition of the animal before and during the breeding season will affect reproductive performance in terms of services per conception, kidding and lambing intervals and the percentages of open ewes and does. Hence, ewes and does should maintain good body condition during the breeding season as well as at the time of lambing and kidding. Similarly, rams and bucks should also be evaluated for proper body condition.

Females that are in good condition should have high pregnancy, twining rates, milk production and good colostrum quality. When the animals are bred in poor condition will increase the incidents of morbidity, the birth of weak and unthrifty kids/lambs and sometimes the does/ewes may abort their fetuses. The doe/ewe may have low milk production and even the doe/ewe may produce kids/lambs with low birth rates (Noble, 2004). Therefore, it is of paramount importance that animals are in optimum condition before the breeding season.

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ISOLATION AND CHARACTERIZATION OF PESTICIDE DEGRADING AND PGPR BACTERIA (*Azotobacter salinestris*)

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Abstract

This study was conducted to isolate the *Azotobacter* strain from the paddy field to explore the plant growth-promoting (PGP) activities and pesticide degrading ability. This isolate has been identified according to 16S-rRNA analysis. The strain *Azotobacter salinestris* was positive for amplification of the nifH gene which is responsible for nitrogen fixation. Furthermore, it produced osmoprotectant substances such as 1-aminocyclopropane-1- carboxylate (ACC) deaminase enzyme, salicylic acid (SA), proline and exopolysaccharide (EPS). *A. salinestris* can use melibiose, galactose, mannitol, sucrose, glucose, and fructose as primary carbon sources. The isolate was tested for pesticide resistance and biodegradation studies and showed 100% biodegradation of pendimethalin residues. *Azotobacter salinestris* helps to replace chemical fertilizer and restore soil fertility and crop productivity for sustainable agriculture.

Keywords: *Azotobacter salinestris*, PGP activities, nifH gene, Osmoprotectant substance

Introduction

Azotobacter salinestris is a Gram-negative, nitrogen-fixing bacterium; its specific name, *salinestris,* comes from the Latin words *salinus* meaning saline and *estris* which means "living in". This organism is motile at younger stages but loses its flagella at older stages. This species is known for its potential use in bioremediation. The bacteria that performed the most efficient atmospheric nitrogen fixation were from samples grown in 0.05% to 0.10% saline concentration soils. Nitrogen fixation rates were not affected by the presence of oxygen. Under abiotic stress conditions, increased proline biosynthesis was observed for various plant species (Vardharajula *et al*. 2011).

A. salinestris was the first prokaryote to show Na+ /succinic acid efflux (Page William and Shivprasad Shailaja, 1991). It can degrade endosulfan, which is an insecticide that

is highly hazardous to human, mammal, and fish health. Endosulfan use was banned in 2012 by the United States, following a precedent established by New Zealand and the European Union. The decision to ban endosulfan use came after a study that showed the health risks to humans and wildlife were much higher than expected. It is similar to dichlorodiphenyltrichloroethane, causes birth defects, and is an estrogen analogue. Therefore, the ability of *A. salinestris* to break down endosulfan is important for bioremediation in the environments where the substance was used (Chennappa, Gurikar *et al*. 2014).

Materials and methods

Isolation- *Azotobacter salinestris*

The isolation process was carried out using a serial dilution technique in the pouring and streaking plate method on winogradsky's Agar medium.

Winogradsky's Agar Medium composition

Sucrose- 2.0gm, KH_2PO_4- 0.15gm , K_2HPO_4- 0.05gm , $MgSO_4$- 0.02gm , $FeCl_3$- 0.01gm, $NaMoO_4$- 0.02gm , Bromophenol blue- (1%) , Alcohol Solution- 5ml , pH- 6.9-7.0, Distilled water- 1000ml

Bacterial Identification Using 16S rRNA Sequence

The PCR amplification program was used as follows: an initial denaturation/ enzyme activation at 95 °C for 10 min then 35 cycles of denaturation at 95°C for 30 s, annealing at 65°C for 60 s and extension at 72 °C for 90 s and a final extension step at 72 °C for 10 min.

Results and Discussion

16srRNA gene sequencing is commonly used for the identification, classification and quantification of microbes within environmental samples. The strain *Azotobacter salinestris* was positive for amplification of the nifH gene which is responsible for nitrogen fixation. DNA was extracted using the protocol of (Thermo K0721). The purified DNA was used for amplification of a total 50µl reaction.

Bands of Agarose gel electrophoresis

Sequence derived from the sample - *Azotobacter salinestris* strain 26

1 atcgccaacg gggctgagac tataaagaaa ggtaaaaaaa tatacgctac actggaaatt

61 ccactaacct ctaccgtact ctagccacgc agttttgaat gcagttcccg ggttgagccc

121 ggggatttca cctccgactt acctgaccac ctacgtgcgc tttacgccca gtaattccga

181 acaacgcttg cacccttcgt attaccgcgg ctgctggcac gaagttagcc ggggcttatt

241 ctgcaggtac cgtcaatatt gccaggggtg caacaacttt ccttccttcc ggccttcatt

301 actctacaat catgagacct tcttcacaca cgcccattgt cctggattcc gctttgcccc

361 cttgtccaat attccccact gctgcctccc gtaggagtct ggaccgtgtc tctttacagt

421 gtaactgatc atcctttcag acgcctttac gatactcacc atgttgggcc gttaccgctc

481 ctactttcta aaccaacctt tgccccgaag gtatcgtgcg gccttaacgt accttacttt

541 gtctcgttcg acataagcgg tcatagcgcg aagtttttac gcattagcct gccgcaacta

601 gtatattgct cggcactggt ctgtcttacg cctttcgccg gcgaaccaaa aggagccatt

661 atcgctctat ttgccccccg ttattcctgc ctcccgacgt actatctgac ccatgatccc

721 cctcctcccc ccgggtttcc ccccaatatt tccccaagtt tcccccccccc ccgaaatatt

781 ccccccccccc ccttctcctc ttttcccccc ccccctttg aaaggcttcc ccgggggtta

841 cccgggggtt tttcaacctt aataaaaaac ccccccagcc ttttttacca caaatttaaa

901 aaaaaatccc ccccccttta taacacccgc gggagggaaa aaaaaaaaag gggggttttt

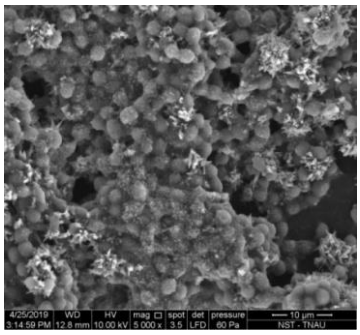
961 ttctgttgaa aaacaacaga aaggggggggg taacagacac ctcaccctcc cggagattga

1021 tgtctctcag agacgagtag tctcttgccc gcgcggagag gcgagtctct cgcgtccccc

1081 tacacaagat gcgcggggtg tctgcata

SEM analysis

SEM analysis is a powerful investigative tool that uses a focused beam of electrons to produce complex, high magnification images of a sample's surface topography. Aerobically grown cells were melanized dark brown to black; the cells were large, oval with pointed ends, and had peritrichous flagella and form pairs and chains during active growth.



SEM analysis of *Azotobacter salinestris*

Biochemical tests

Biochemical tests are the tests that are performed on different bacteria for their identification based on their biochemical activities towards different biochemical compounds. The presence

or absence of certain enzyme metabolites or end products gives valuable information in identifying and classifying micro-organisms.

1. Citrate utilization test

The citrate utilization test is used to differentiate enteric bacteria. The media contains sodium citrate, which serves as the carbon source and ammonium phosphate as the source of nitrogen. 5 ml of simmon citrate agar media (Magnesium sulphate 0.20 g/l, Ammonium dihydrogen phosphate 1g/l, Dipotassium phosphate 1g/l, Sodium citrate 2g/l, Sodium chloride 5 g/l, Bromothymol blue 0.08 g/l, Agar 15 g/l, pH - 6.8 ± 0.2) was poured into a test tube and swabbed the culture inside the media using a needle and incubated the culture for 24 h at 37^0 C.

2. Urease production

It helps to detect bacteria that can produce urease enzymes which split urea into $NH_3$and CO_2. 5ml of media (Dextrose 1g/l, Peptone 1g/l, Sodium chloride 5g/l, Monopotassium phosphate 2 g/l, Urea 20 g/l, Phenol red 0.012 g/l, pH 6.8 ± 0.2) was prepared and poured into a test tube and then the culture was swabbed inside the media by using a needle. The culture in the media was incubated at 37^0 C for 24 h.

3. Catalase test- Slide method

Use a loop or sterile wooden stick to transfer a small amount of colony growth to the surface of a clean, dry glass slide. A drop of 3 percent hydrogen peroxide in the glass slide was placed. The evolution of oxygen bubbles was observed**.** The enzyme catalase mediates the breakdown of hydrogen peroxide into oxygen and water. The presence of the enzyme in a bacterial isolate is evident when a small inoculum is introduced into hydrogen peroxide and the rapid elaboration of oxygen bubbles occurs. The lack of catalase is evident by a lack of (or) weak bubble production. The culture should not be more than 24 hours old.

Table- 1 Biochemical tests for identification of Bacteria

Biochemical tests	Results
Gram Staining	Positive
Motility	Motile
Catalase test	Positive
Urease test	Positive
Citrate test	Positive
Glucose	Positive
Fructose	Positive

Urease test

Citrate test

Catalase test

Conclusion

A. salinestris was found to share many of the general characteristics specific to the species *Azotobacter.* Originally, *A. salinestris* colonies were classified as *Azotobacter chrococcum* but later identified as a separate species based on their salt-dependent growth. *Azotobacter salinestris* is considered a high potential PGPR and can offer an environmentally sustainable approach to increasing crop production under saline conditions. It can tolerate up to 5% glyphosate, which is a pesticide used to kill weeds that compete with crops.

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LONG TERM & SHORT TERM FOCUS OF BUSINESS STRATEGY

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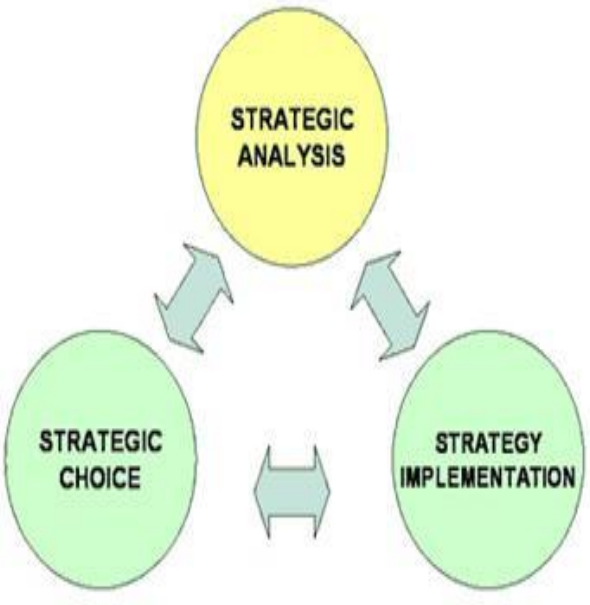
Introduction

Strategy is the ***direction*** and ***scope*** of an organization over the ***long-term:*** which achieves advantage for the organization through its configuration of ***resources*** within a challenging environment, to meet the needs of ***markets*** and to fulfil ***stakeholder*** expectations".

In other words, strategy is about:

- Where is the business trying to get to in the long-term (**direction)**
- Which markets should a business compete in and what kinds of activities are involved in such markets? (**Markets**; **scope**)
- How can the business perform better than the competition in those markets? (**Advantage**)?
- What resources (skills, assets, finance, relationships, technical competence, facilities) are required to be able to compete? (**resources**)?
- What external environmental factors affect the businesses ability to compete? (**environment**)?
- What are the values and expectations of those who have power in and around the business? (**stakeholders)**

How strategy is managed - Strategic Management



In its broadest sense, strategic management is about taking "strategic decisions" - decisions that answer the questions above. In practice, a thorough strategic management process has three main components, shown in the figure

Strategic Analysis

Strategic analysis is all about analyzing the strength of a businesses' position and understanding the important external factors that may influence that position. The process of Strategic Analysis can be assisted by several tools, including:

PEST Analysis - a technique for understanding the "environment" in which a business operates

Scenario Planning - a technique that builds various plausible views of possible futures for a business

Five Forces Analysis - a technique for identifying the forces which affect the level of competition in an industry

Market Segmentation - a technique that seeks to identify similarities and differences between groups of customers or users

Directional Policy Matrix - a technique that summarizes the competitive strength of a businesses operations in specific markets

Competitor Analysis - a wide range of techniques and analysis that seeks to summarize a businesses' overall competitive position

Critical Success Factor Analysis - a technique to identify those areas in which a business must outperform the competition to succeed

SWOT Analysis - a useful summary technique for summarizing the key issues arising from an assessment of a business's "internal" position and "external" environmental influences.

Strategic Choice

This process involves understanding the nature of stakeholder expectations (the "ground rules"), identifying strategic options, and then evaluating and selecting strategic options.

Strategy Implementation

Often the hardest part. When a strategy has been analyzed and selected, the task is then to translate it into organizational action.

A global industry

A global industry can be defined as:

- An industry in which firms must compete in all world markets of that product to survive.
- An industry in which a firm's competitive advantage depends on economies of scale and economies of scope gained across markets.
- Global markets are international markets where products are largely standardized. Michael Porter argued that industries are either multi-domestic or global.

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MEDICINAL TREES

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Introduction

Plants especially trees are playing a key role in the human life since our origin. They fulfil our basic needs such as food and shelter. Apart from the basic needs, trees have an important role in traditional medicinal system which are included in the modern systems of medicine also. Traditional medicine has been used for thousands of years with great contributions made by practitioners to human health, particularly as primary health care providers at the community level and has maintained its popularity worldwide. All the Indian traditional medicine systems are based on plant sources. Several medicinal trees and their products are still in home remedies and represent a considerable portion of global drug market.

Bael

Bael belongs to the family Rutaceae and is botanically known as *Aegle marmelos*. It is native to India and found to spread in Sri Lanka, Burma, Bangladesh and Indo China. The tree is aromatic and very important in Ayurvedic medicine. All parts *viz.* fruits, leaves, bark, roots and seeds are used in various traditional medicinal systems. Extensive experimental and clinical studies prove that *Aegle marmelos* possesses antidiarrhoeal, antimicrobial, antiviral, radioprotective, anticancer, chemopreventive, antipyretic, ulcer healing, antigenotoxic, diuretic, antifertility and anti-inflammatory properties, which help it to play role in prevention and treatment of many diseases.

Phytoconstituents of medicinal importance in *A. marmelos* are Aegelenine, Aegeline Aegelinosides A, Aegelinosides B, Fragrine, Halfordinol, Alloimperatorin, Imperatorin, Isoimperatorin, Marmelide, Marmelosin, Marmesin, Marmin, Psoralen, Psoralen-a, Scoparone, Scopolentin,

Umbelliferone, Xanthotoxol and Zanthotoxol. The terpernoids *viz.,* Caryophyllene, Cineol, Cubedol, Elemol, Hexanylhexanoate, Humulene, Isosylvestrene, Limonene, Linalool, Valencene were also reported to be present in various parts of *Aegle marmelos*.

Wood Apple

Wood apple is a part of the family Rutaceae and botanically known as *Feronia limonia.* Its origin is subtropical India and found in Sri Lanka, Pakistan, Java and Malaysia. It is widely used as liver and cardiac tonic. Various parts of wood apple are being used in traditional medicinal systems. Unripe Fruits are useful in diarrhoea, dysentery, pruritus and pharyngodynia. Ripe fruits cures cough, dysentery, heart diseases, vomiting; removes biliousness, blood impurities, fatigue, thirst, asthma, tumours, ophthalmia, leucorrhoea, scurvy. The juice cures earache. The leaves are used as antiemetic, hiccough and dysentery as carminative, cardiotonic, and expectorant, purgative, also useful in anorexia, bronchitis, calculus, cough, diarrhoea, gastropathy, and hiccup. Bark is useful in certain liver diseases. Pharmacological activities such as antitumour, antimicrobial, antidiabetic, anti-inflammatory, analgesic, antioxidant, hepatoprotective, antimutagenic, antimalarial and other activities have been exhibited by the extracts and pure compounds derived from wood apple.

Wood apple constitutes auraptene, osthol, osthenol, xanthyletin, isopimpinellin, bergapten, methoxsalen, psoralen, Demethylsuberosin, orientin, vitexin, saponarin, umbelliferone, marmin, marmesin and peronoil in various parts.

Neem

Neem is botanically known as *Azadirachta indica* and belongs to the family Melaiceae. Neem is native to the Indian subcontinent and to dry areas throughout South Asia. It has been introduced to parts of Africa, Caribbean and numerous counties in South and Central America. It has long been used in Ayurvedic and Siddha medicine. The leaves and bark possess antimicrobial, antifungal, anthelmintic, insecticidal, antiviral, antipyretic, antimalarial, antiperiodic, mosquito larvicidal, anti-inflammatory, antifertility, spermicidal, hypoglycaemic activities. It is used in the treatment of gingivitis, periodonitis, sores, boils, enlargement of spleen, malarial fever, fever during childbirth, measles, smallpox, head scald and

cutaneous affections. Oil is used as a contraceptive, treatment of vaginal infections, and as a mosquito repellent.

More than biologically active compounds have been isolated from various parts of Neem. The major constituents are Azadirachtin, Salanin, Azadiradione, Nimbinene, Azadirachtanin, Azadirachtanin-A, Vilasinin, Hyperoside, Isoazadirolide, Nimbaflavone, Nimbandiol, Nimbinene, Nimbolide, Quercetin, Quercitrin, Rutin, Nimbin, Nimbolide, Margolone, Margolonone, Isomargolonone, Quercetin, Salanin, Nimbolin A, Nimbolin B, Nimbinin, Azadiradione, Azadirone.

Prickly Custard Apple

Annona muricata is the botanical name of mulseetha which belongs to the family Annonaceae. Fruit juice and infusion of leaves are used in the treatment of fever, malarial and gastro intestinal problems. *A. muricata* is also used in treatment of diabetes and cancer. Unripe fruit, seeds, leaves and roots are used as biopesticides, bioinsecticides and topical insect repellents. In various countries it has been used in traditional medicine systems. Bark is used as tonic, roots for spasms and parasites, flower as bechic and seeds as astringent in India.

Five acetogenins, Muricatalicin (I), muricatalin (VI), annonacin (II), annonacin-A (III), annonacin-10-one (IV) a mesitoate of acetogenin, annonacin-B mesitoate (Vb) were present in various parts of *A. muricata*. Reticuline, coclaurine, coreximine, atherosperminine, stepharine, anomurine and anomuricine were reported in leaves. Calarene, annomuricatin A, Annohexocin, Murisolin, Annoreticuin-9-one, Cis-annoreticuin, Sabadelin, Annonaine, Nornuciferine, Asimilobine, epomusenin-A, epomusenin-B, epomurinin-A, epomurinin-B, muricin J, muricin K, muricin L were the other phytochemicals present in fruits of *A. muricata.*

Citron

Citron botanically *Citrus medica* is a member of the Rutaceae family and known as narthangai in tamil. It is originated in Southeast Asia, spread to Japan, Bangladesh, Arabia, Australia, Africa. The roots of *C. medica* has antiparasitic activity, used for treating constipation and tumours. The peel of the fruit is used for relief from bad breath. Seeds have pungent taste and

used as stimulant and tonic. The decoction of shoots enhance appetite and are used to remive intestinal worms. Leaves are used in treating liver related problems. The ripe fruit is sweet & sour, Stimulant, digestible, tonic, relieves leprosy, cure sore throat, cough, asthma, hiccough, good for throat & the juice decreases earache.

Recent studies have shown that the fruit has anti-catarrhal, capillary protector, anti-hypertensive, diuretic, antibacterial, antifungal, anthelmintic, antimicrobial, analgesic, strong antioxidant, anticancerous, antidiabetic, estrogenic, antiulcer, cardioprotective, and antihyperglycemic acitivity. Neoeriocitrin, Naringin, Neohesperidin, Rhoifolin, β-Cryptoxanthin, hesperidin, limonol, nomilinic acid, hesperidoside, naringoside and ecryodietyoside are the phytochemicals reported in various parts of *c. medica.*

South Indian Mahua

Madhuca indica is the botanical name of South Indian Mahua and known as iluppai in Tamil. The flowers are used in renal diseases, fruits in rheumatism, cough, asthma and consumption. The bark of the tree is used for rheumatism, chronic bronchitis, diabetes mellitus, decoction for rheumatism, bleeding and spongy gums. The fruits are also edible and used to treat ulcer (as lotion), in acute and chronic tonsillitis and pharyngitis. The various parts of the plants have the properties as stimulant, demulcent, emollient, heating. Skin disease, rheumatism, headache, laxative, piles, and galactogogue astringent. Seed oil is used to treat rheumatism. The seed cake is reported to have insecticidal and pesticide property. Madhuca has Mi-saponins A, B, C in seed kernels which possess anti-inflammatory and antiulcerogenic activities

Indian gooseberry

Indian gooseberry belongs to the family Euphorbiaceae and is botanically *Phyllanthus emblica*. Native to tropical Southeast Asia and distributed throughout India. Fruit has antianaemic, anabolic, antiemetic, bechic, astringent, antihaemorrhagic, antidiarrhoeal, diuretic, antidiabetic, carminative, antioxidant activity. It is used in treatment of jaundice, dyspepsia, bacillary dysentery, eye trouble and as a gastrointestinal tonic. Seeds possess antibilious, antiasthmatic activities and for treating bronchitis. Bark has astringent property. Leaf juice reduces vomiting. A decoction of powdered pericarp used in treatment for peptic ulcer.

Estradiol, Astragallin, Leucodelphinidin, Beta amvirin, Rutin, Pedunculagin, Zeatin, Quercetin, Phylianthin, Emblicanin A, Emblicanin B, pedunculagin and punigluconin are the major phytochemicals of medicinal importance in Indian Gooseberry.

Ashoka tree

It is botanically *Saraca asoca* belonging to the family Caesalpinaceae. Traditionally bark of Ashoka tree is used as uterine tonic (imparts healthy tone to uterus), used for suppressed menses, leucorrhoea, menstrual pain, menorrhagia, complaints of menopause. It is also used in the treatment of dyspepsia. The flowers are used for curing haemorrhagic dysentery, bleeding piles and retention of urine.

Quercetin, Leucocyanidin, Leucopelargonidin, Catechin, Epicatechin, 3′,5-Dimethoxy epicatechin, Procyanidin, Gallocatechin, Epigallocatechin, Haematoxylin, Pelargonidin-3,5-diglucoside, 3′-Deoxyepicatechin, Schizandriside are the phytochemicals present in various parts of *Saraca asoca*

Tree Jasmine

Jasminum arborescens is the botanical name of tree jasmine belonging to the family of Oleaceae. Leaves has astringent property. Juice of the leaves, with pepper, garlic and other stimulants, is used as an emetic in obstruction of the bronchial tubes due to viscid phlegm. The leaves are used in treatment of mouth ulcers and also in ear ache. The leaves of *Jasminum arborescens* expressed promising anthelmintic activity.

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MICRO, SMALL AND MEDIUM ENTERPRISES (MSME)S - ROLE AND IMPORTANCE IN INDIA'S ECONOMY

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Introduction

MSMEs, Micro, Small and Medium Enterprises play an essential role in the development of our Indian economy. MSMEs are the backbone of Indian economy and acts as a engine for growth of economy. In India, MSMEs contribute nearly 8% of the country's GDP, around 45% of the manufacturing output, and approximately 40% of the country's exports. The Government of India has introduced MSME or Micro, Small, and Medium Enterprises in agreement with Micro, Small and Medium Enterprises Development (MSMED) Act of 2006. These enterprises primarily engaged in the production, manufacturing, processing, or preservation of goods and commodities. Micro, Small and Medium Enterprises (MSMEs) sector has emerged as a highly vibrant and dynamic sector of the Indian economy over the last five decades. MSMEs not only play a crucial role in providing large employment opportunities at comparatively lower capital cost than large industries but also help in industrialization of rural and backward areas, thereby, reducing regional imbalances, assuring more equitable distribution of national income and wealth. MSMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country.

MSMEs Redefined

A proposal was made to redefine MSMEs by the Micro, Small and Medium Enterprises Development (Amendment) Bill, 2018, to classify them as manufacturing or service-providing enterprises, based on their annual turnover.

A micro enterprise will be defined as a unit where the annual turnover does not exceed Rs 5 crores;

A small enterprise will be defined as a unit where the annual

turnover is more than Rs 5 crore but does not exceed Rs 75 crore

A medium enterprise will be defined as a unit where the annual turnover is more than Rs 75 crore rupees but does not exceed Rs 250 crore

Additionally, the Central Government may, by notification, vary turnover limits, which shall not exceed thrice the limits specified in Section 7 of the MSMED Act.

Table: 1 MSME Classification: (Based on Annual Turnover) - Goods & Services Category

Classification of the MSME	New Classification (Annual Turnover)	Previous Classification - Ceiling on Investment in Plant and Machinery (in Rs.)
Micro	Up to Rs. 5 Cr	Below 25 lakhs
Small	Between Rs. 5 Cr to 75 Cr	25 lakhs to 5 crores
Medium	Between Rs. 75 Cr to 250 Cr	5 crores to 10 crores

Under the previous classification a separate methodology was adopted for service sector. Now the classification was made similar to the goods MSMEs as the general turnover-based criteria were made applicable to service sector also.

In 2015, the government has introduced an amendment bill to change the limit in all categories and it was adopted in February 2018.

Benefits of the above-proposed reclassification

According to the proposed reclassification or the new classification, there would be no need for frequent inspections to check the investment in plant and machinery. Also, the operations of MSMEs would be transparent, non-discriminatory, and objective in nature.

Features of MSMEs

Following are a few highlighting features of new MSMEs:

1. A provision of Collateral Free Loans to MSMEs.
2. An arrangement of loans to MSMEs worth of Rs. 3 lac crores.
3. An offer for MSMEs to get a Moratorium period of 12 months.

4. Consideration of Manufacturing and Service MSMEs as the same entities.
5. MSM is a granted a repayment Tenure of 48 months.
6. MSMEs are assured a 100% Credit Guarantee.
7. Reclassification of MSMEs will benefit approximately 45 Lac units.

Essential elements of MSMEs

1. MSMEs work for the welfare of the workers and artisans. They help them by giving employment and by providing loans and other services.
2. MSMEs provide credit limit or funding support to banks.
3. They promote the development of entrepreneurship as well as up-gradation of skills by launching specialized training centers for the same.
4. They support the up-grading of developmental technology, infrastructure development, and the modernization of the sector as a whole
5. MSMEs are known to provide reasonable assistance for improved access to the domestic as well as export markets.
6. They also offer modern testing facilities and quality certification services.
7. Following the recent trends, MSMEs now support product development, design innovation, intervention, and packaging.

Role and Importance in Indian Economy

To Generate Large Scale Employment in India

Capital is scarce and labour abundant. MSMEs are thought to have lower capital-output and capital-labour ratios than large-scale industries, and therefore, better serve growth and employment objectives. The MSME sector in India has grown significantly since 1960 – with an average annual growth rate of 4.4% in the number of units and 4.62% in employment (currently employing 30 million). Not only do MSMEs generate the highest employment per capita investment, they also go a long way in checking rural-urban migration by providing people living in isolated areas with a sustainable source of employment.

To Sustain Economic Growth and Increase Exports

Non-traditional products account for more than 95% of the MSME exports (dominating in the export of sports goods, readymade garments, plastic products etc.). Since these products are mostly handcrafted and hence eco-friendly, there exists a tremendous potential to expand the quantum of MSME led exports. Also, MSMEs act as ancillary industries for Large Scale Industries providing them with raw materials, vital components and backward linkages e.g., large scale cycle manufacturers of Ludhiana rely heavily on the MSMEs of Malerkotla which produce cycle parts.

Making Growth Inclusive

The inclusive growth is at the top of the agenda of Ministry for Medium, and small and Medium sized enterprises for several years. On the other hand, poverty and deprivation are a deterrent to the development of India. Besides, it includes marginalized sections of a society which is a key challenge lying before the Ministry of MSME. MSMEs are instruments of inclusive growth which touch upon the lives of the most vulnerable and marginalized. For many families, it is the only source of livelihood. Thus, instead of taking a welfare approach, this sector seeks to empower people to break the cycle of poverty and deprivation. It focuses on people's skills and agency. However, different segments of the MSME sector are dominated by different social groups.

The Twelfth Plan has listed the following as the objectives for the MSME sector

- Promoting competitiveness and productivity in the MSME space.
- Making the MSME sector innovative, improving technology and depth.
- Enabling environment for promotion and development of MSMEs.
- Strong presence in exports.
- Improved managerial processes in MSMEs

Economic Stability in terms of Growth and Leverage Exports

It is the most significant driver in India contributing to the tune of 8% to GDP. Considering the contribution of MSME to manufacturing, exports, and employment, other sectors are also benefitting from it. Nowadays, MNCs are buying semifinished, and auxiliary

products from small enterprises, for example, buying of clutches and brakes by automobile companies. It is helpful in creating a linkage between MSME and big companies even after the implementation of the GST 40% MSME sector also applied GST Registration that plays an important role to increase the government revenue by 11%.

Cheap Labor and Minimum Overhead

While in the large-scale organizations, one of the main challenge is to retain the human resource through an effective human resource management professional manager. But, when it comes to MSME, the requirement of labour is less and it does not need a highly skilled labourer. Therefore, the indirect expenses incurred by the owner is also low.

Simple Management Structure for Enterprises

MSME can start with limited resources within the control of the owner. From this decision making gets easy and efficient. On the contrary, a large corporation requires a specialist for every departmental functioning as it has a complex organizational structure. Whereas a small enterprise does not need to hire an external specialist for its management. The owner can manage himself. Hence, it could run single-handedly.

The Main Role in the Mission of "Make in India"

The signature initiative by the Prime Minister of India "Make in India" has been made easy with MSME. It is taken as a backbone in making this dreams a possibility. In addition, the government has directed the financial institution to lend more credit to enterprises in the MSME sector.

Conclusion

The Indian MSME sector provides silent support to the national economy and acts as a defense against global economic shock and adversities. Hence, we can say that India is propelling towards a robust global economy through a silent revolution powered by MSMEs.

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PROMOTION OF OYSTER MUSHROOM PRODUCTION TECHNOLOGY IN THE INTEGRATED FARMING SYSTEM FOR SUSTENANCE THROUGH TRAINING PROGRAMME

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Introduction

Mushrooms are increasingly considered a future vegetable owing to their nutraceutical properties, the consumer demand for various types of mushrooms has expanded in recent years. In India, there are five mushroom species *viz*., white button mushroom (*Agaricus bisporus*), oyster (*Pleurotus* spp.), paddy straw (*Volvariella volvacea*), milky (*Calocybe indica*) and shiitake (*Lentinula edodes*) exploited commercially. There has been a significant increase in the production of mushrooms in the last few years in India, especially the oyster mushroom. The major states in India producing this mushroom are Orissa, Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu, Madhya Pradesh, West Bengal and most of the North-Eastern hill states.

Market strategy and potential

The Oyster mushroom is not as popular as the white button mushroom in the domestic market. A few units are cultivating it commercially for the export market. Cultivation of this mushroom on a commercial basis would be more profitable as compared to white button mushrooms as capital costs are low. Although the current share of India in world exports is less than 1 percent, India has great export potential. European Union and the United States are the biggest markets.

In this scenario, the production map given in the TNAU Agritech portal depicts that the contribution of the Pudukkottai district to mushroom production is less than 1%. In 2018, the Pudukkottai district was adversely affected by the Gaja cyclone over an area of 2219.70 ha. Being an economically backward district, the ravages caused by the cyclone has badly

affected the lively hood of the people and the economy of the district. The current COVID condition has left the common man in debt incurring heavy losses in all walks of life, hence the post-COVID situation warrants speedy recovery of his economy. Thus, the combined crisis in the Pudukkottai district demands viable technologies which can bring significant improvement to the farmers who are the most affected. Therefore, the scope for the production of oyster mushrooms is wide in this region and there is a great potential for the adoption of the oyster mushroom production technology. In addition, the medicinal and nutritional properties of mushrooms when included in the diet can enhance the health condition and decrease the vulnerability of people to diseases. Hence production based on the consumer market and value addition in case of large-scale production create huge market potential for farmers who can exploit this market by the adoption of the oyster mushroom production technology. With this background, three days of training were organized in two batches from 17.08.2021 to 19.08.2021 and 18.08.2021 to 20.08.2021 at Agricultural College and Research Station, Kudumiyanmalai, Pudukkottai district to promote the cultivation in this region with the assistance of NABARD funding.

Glimpses of the training programme

The trainings were inaugurated by Dr. T. Senguttuvan, Dean, Agricultural College and Research Station, Kudumiyanmalai and Course Director who during his address stressed that there is ample scope for the adoption of oyster mushroom technology in the Pudukkottai region. He elaborated on the importance of mushrooms and stressed that the inclusion of such food regularly will increase the immunity of an individual. A special address was delivered by all the heads of departments emphasising the various benefits of consuming mushrooms and the enhancement of the farmer's economy by taking up this venture. Miss. S. Jayasree, DDM, NABARD, Pudukkottai addressed the gathering during the valedictory function insisting on the importance of mushroom production as an allied sector of agriculture and utilising the services of technical expertise available with Agricultural College and Research Institute, Kudumiyanmalai. The investment opportunities available in the sector and the process to apply for

funding from NABARD were detailed by her. The additional income that could be generated through mushroom production and the role of the banking sector in aiding such activities were elaborated.

Dr. T. Saravanan, Assistant Professor (Pl. Pathology), ADAC & RI, Trichy summarised the status of mushroom production in Indian conditions, the various states which are pioneering in the production of different mushrooms *viz*., button, oyster, milky and paddy straw mushroom. He spoke about the multiple opportunities in this sector which can be exploited by the farmers to become successful entrepreneurs. The importance of mushrooms as food, the nutritional & pharmaceutical values of mushrooms in curing various diseases and as decomposing agent of farm waste were detailed. As an entrepreneurial sector, the benefits a farmer gets by investing and integrating mushroom production in the Integrated Farming System (IFS) were drawn in by Dr. Jagadeesan, Asst. Professor (Agri. Extension). When included in the integrated farming system, the use of available family labour leading to a reduction in the cost of production was specified. He explained the various strategies of marketing the harvested mushroom highlighting the ways to create demand and to reach the customers. Since the shelf life is minimum for mushrooms, value addition and marketing can fetch more profit were the key points of his lecture.

The Importance of mushroom production in the farming sector, followed by oyster mushroom production technology was delivered by Dr. N. Revathy, Associate Professor (Pl. Pathology). She gave an introduction to oyster mushrooms, the varieties released by TNAU to date and the uses of each mushroom. The preparation of the mushroom bed from the spawn in a sequential manner and incubation of the bed for the fruiting body production was detailed. The conditions to be maintained as well as the dos and don'ts to be adopted in the spawn running room and the cropping room were elaborated. The maintenance of the bed during the incubation period, harvesting period and harvesting methods to be followed were explained with a video show on the production of oyster mushrooms from the spawn. Spawn production ie., mushroom seed production is considered another entrepreneurial sector in mushroom production, fetching more profit by the

sales of the spawn to other mushroom units. This session, on the preparation of spawn using sorghum grains as recommended by TNAU, was explained by Dr. A. Vijayasamundeeswari, Assistant Professor (Pl. Pathology). The demonstration was done on the following aspects *viz*., mother spawn & bed spawn preparation; inoculation of the spawn bag with mushroom culture; incubation of the inoculated material for the growth of fungal mycelium and maintenance spawn bag.

The incidence of insect pests and diseases and their management was delivered by Dr. R. Nalini, Professor & Head, Department of Crop Protection exhibiting the photos of symptoms expressed due to the infection. She detailed the various insect pests like sciarid fly, phorid fly and diseases like dry bubble, wet bubble, cob web, green moulds, bacterial blotch, and viral diseases which cause major damage to the production units. Intensive care needed every day to keep the pests under control especially the moisture, relative humidity, light intensity, and ventilation inside the units to be maintained as per the standardised protocol was elaborated. The clean surroundings around the mushroom unit were also insisted as drainage, manure pits, etc., may invite pests leading to further secondary infections. If management is not done as per the standards specified, will lead to heavy loss in the production eventually resulting in the closing of the unit being emphasised.

The value addition of the mushroom which has a very big market was well explained by Dr. M. Umadevi, Asst. Professor**.** The produce harvested in excess or the unsold produce can be easily converted into different recipes which attract large customers. She also explained the various recipes, savouries and sweets that can be made with mushrooms. Since mushrooms have high nutraceutical value, the value-added products can cater continuously to the health needs of people of all groups.

Hands-on training on the production of oyster mushroom bed preparation was conducted by Dr. P. Ahiladevi, Assistant Professor (Pl. Pathology), NPRC, Vamban**.** The participants practised the preparation of a mushroom bed using paddy straw and mushroom spawn. Polythene bags of 80-gauge thickness and 60 x 30 cm size were used for the purpose and paddy straw was stacked first followed by spawn, likewise, a total of 5 layers of

paddy straw and spawn were stacked alternatively to prepare the bed. At the end of the session, the participants were taken to the Mushroom Unit at AC & RI, Kudumiyanmalai to see the mushroom bed with fully grown mycelium and beds with sprouting fruiting bodies in the shed. The field visit was also arranged to Naaga Mushroom's manufacturing & marketing owned by Mr. K. Vengatesan in Malaikudippatti village, Illuppur Taluk of Pudukkottai district who has attended training at Tamil Nadu Agricultural University, Coimbatore during 1999, since then been in association with the scientists of TNAU. He shared his knowledge and experience gained at TNAU and the difficulties faced by him as a beginner and lessons learnt due to various problems in the products which have made his agribusiness successful. He has three units, each of 420 sq. ft area in which 20 kg per day of fresh mushrooms is produced and marketed to the nearby cities *viz*., Madurai, Trichy, etc and also to the local market at Pudukkottai @ Rs. 200 per kg. In addition, spawn with sorghum as the substrate is also sold to other mushroom growers @ Rs. 40 per bag of spawn. The excess mushrooms harvested are used for making value-added products *viz*., pickles, soup powder, pasta, etc. The participants were motivated by his various activities at his unit.

The certificate for participation was given to 64 participants. Finally, Dr. T. Senguttuvan, Dean, Agricultural College and Research Station, Kudumiyanmalai,

Miss. Jayasree, District Development Manager, NABARD, Pudukkottai, Dr. R. Nalini Professor and Head, (DCP), and Dr. M. Madhan Mohan, Associate Prof & Head (DCI) distributed the inputs for take-home activities *viz*., Oyster mushroom spawn, polythene bag and thread ball for bed preparation. Dr. A. Vijayasamundeeswari and Dr. N. Revathy, programme coordinators thanked NABARD for funding and all those who worked for the successful conduct of the training programmes, eventually bidding the participants become successful entrepreneurs.


காளான் வகைகள்

Information

For the benefit of the farmers, one day of training is given at Tamil Nadu Agricultural University, Coimbatore and its constituent colleges as follows on-spot registration at 9 am and a fee of Rs. 590 (including GST).

S. No.	Place	Date
1.	Tamil Nadu Agricultural University, Coimbatore – 641 003	5th of every month. If the 5th is a government holiday or Sunday the training is on the next working day
2.	Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli - 620 027	10th of every month. If the 10th is a government holiday or Sunday the training is on the next working day
3.	Agricultural College and Research Institute, Madurai – 625 104	15th of every month. If the 15th is a government holiday or Sunday the training is on the next working day

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SEQUENCE CAPTURE TECHNOLOGIES FOR ACCELERATED CLONING OF RESISTANCE GENES FROM BANANAS

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Introduction

Banana is one of the most important fruit crops in India. This tropical fruit crop is widely consumed and plays a significant role in the socio-economic and cultural heritage of India. Currently, India ranks first with a production of 27.0 million tons as compared to the world production of over 97.5 million tons. Banana cultivation is subjected to many natural calamities, but, pests and diseases constitute the major problem. Among them, *Fusarium* wilt, leaf spot and nematodes contribute to major yield loss in bananas at the global level. Despite substantial documented progress in planting banana-resistant cultivars and implementing biological, chemical, and cultural measures, management is largely restricted to excluding these pests and pathogens. Although resistance exists in some wild bananas, attempts to introduce resistance into commercially acceptable bananas by conventional breeding often require long breeding timelines to break the linkage between resistant (R) genes and deleterious alleles. Further, R genes confer resistance to a more specific range of pathogens and when R genes are introgressed one at a time the resistance conferred by them may be overcome by pathogen during its course of evolution. With the availability of several cloned R genes, pyramiding would be possible in bananas, which might provide more durable resistance against these pests and pathogens.

Identification of R genes is difficult due to the non-availability of appropriate techniques for tracking large complex genomes. Earlier transposons were used to tag R genes with known DNA sequences. The maize *HM1*, the first R gene to be cloned followed by *N*, *Cf-9* and *L6* genes of tobacco, tomato and flax, respectively were by transposon tagging (Johal and Briggs, 1992; Jones *et al*., 1994;

Whitham *et al*., 1994; Lawrence *et al*., 1995). Chromosome walking, using map based positional cloning was performed to clone the R genes through molecular markers for which chromosome libraries are needed. Many genes like *rps2*, *xa21* and *pto* genes from Arabidopsis, rice and tomato, respectively were cloned by this method (Martin *et al*., 1993; Bent *et al*., 1994; Song *et al*., 1995; Staskawicz *et al*., 1995).

Traditional map-based cloning of R genes, however, is still challenging, as large tracts of plant genomes are inaccessible to map-based genetics due to lack of recombination and most R genes belong to a structural class of genes called NB-LRRs, which tend to reside in complex clusters, and many hundreds of NB-LRRs populate a typical plant genome. Rapid advancements in DNA sequencing and bioinformatics technologies have allowed innovative strategies to be devised, by-passing walking procedures. Genome complexity can also be reduced through a target gene approach where sequences related to a specific gene family are enriched from the whole genome. Some of the target genes accelerated approaches are resistance gene cloning through mutational mapping (MutMap), cloning through mutant chromosome sequencing (MutChromSeq), rapid cloning through resistance gene enrichment and sequencing (RenSeq) and mutagenesis resistance gene enrichment and sequencing (MutRenSeq).

Resistance gene cloning through mutational mapping (MutMap)

R genes are identified and cloned rapidly through mutagenesis, gene mapping and whole genome sequencing. Ethyl methane sulfonate (EMS), sodium azide and gamma-radiation are used to create mutations, leading to loss of function gene mutants. The bulk segregant analysis approach is followed to identify the mutations in the gene of interest from the homozygous F2 populations. Both the bulked and the wild type parents are sequenced and fine mapped against the reference genome to identify the SNPs (Abe *et al*., 2012). Pii, the rice blast resistance gene was cloned using the MutMap-Gap method (Takagi *et al*., 2013). This method can be employed for gene isolation from the crop with smaller genomes with complete reference sequences than for polyploidy crops with the complex genomes.

Cloning through mutant chromosome sequencing (MutChromSeq)

The genome complexity in polyploids can be reduced drastically by the isolation of specific chromosomes along with mutagenesis (Sanchez-Martin *et al*., 2016). In this method, for the detection of SNPs or deletions in the R genes, the parental chromosome DNA is sequenced to which the mutant chromosomal sequence is mapped. Sanchez- Martin *et al*. (2016), cloned the *Pm2*, powdery mildew disease resistance gene from wheat. This method can be exploited only in crops where chromosome isolation and purification are available along with the mapping position of the target gene.

Rapid cloning through resistance gene enrichment and sequencing (RenSeq)

Resistance Gene Enrichment Sequencing (RenSeq) is one of the target gene approaches and has been successfully used to narrow down the candidate list and accelerate its cloning, particularly where resources and time are limited. RenSeq is an exome-sequencing method that is targeted to nucleotide-binding leucine rich repeats (NLR) family of genes and it aids in the isolation of NLR genes from wild species, which plays a major role in resistance against the pathogen (Jupe *et al*., 2013; Jones *et al*., 2016). Chen *et al*. 2018, has used DNA capture technology for the identification and rapid mapping of a gene conferring broad spectrum late blight resistance in the diploid potato species *Solanum verrucosum*. A major limitation of RenSeq is the precise assembly of Illumina short reads from all the NLR genes, which can be overcome by using PacBio long read technology and this method has been used to isolate the *Rpi-amr3i* gene against potato late blight (Witek *et al*., 2016).

Mutagenesis Resistance gene enrichment and Sequencing (MutRenSeq)

Mutagenesis Resistance gene enrichment and Sequencing (MutRenSeq) is an effective tool wherein which we combine the mutagenesis along with the RenSeq to isolate R resistance genes. This technology has been exploited in the identification of *Sr22* and *Sr45* genes conferring resistance to wheat stem rust based on nucleotide changes between the mutant and wild-type NLR contigs. These genes were previously un-clonable using conventional positional approaches (Steuernagel *et al*., 2016).

Accelerated Cloning of Resistance Genes from banana

MutRenSeq method can be exploited in bananas to isolate R genes against many pests and pathogens whereas in other methods we need to have homozygous population and chromosome isolation, purification protocols. Banana NLRs from loss-of-function mutants and resistant cultivar harboring the gene of interest will be enriched and then assembled. The R gene of interest can be identified based on nucleotide changes between the mutant and wild-type NLR contigs. India being the centre of origin and diversity for bananas has got many wild bananas with resistance to various pests and pathogens. Thus, MutRenSeq is a powerful tool to isolate R genes from banana wild species which are divergent from the domesticated bananas.

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RESTRICTED OR PROHIBITED DRUGS IN VETERINARY PRACTICES AND FOOD ANIMALS

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Introduction

Treatment of food animals with medications has the potential to cause drug residues in the tissue. All drugs have specific directions for use that are provided on the drug label. In some cases, these directions can be modified by a qualified veterinarian, known as extra-label drug use (ELDU). However, there are some compounds that pose a big enough risk to human food safety that any use other than that specified on the drug label is prohibited. This list of FDA prohibited drugs may be found in title 21 of the code of federal regulations part 530.41. When a medication is prohibited, in general, the reason for prohibition falls under one of three categories. Residues can cause cancer, can cause toxic reactions or can cause antimicrobial resistance.

1. Diclofenac

They are found **to vulture toxic drug**. As it causes increased uric acid level which leads to deposition of uric acid in and on the internal organs and ultimately results in kidney **failure and death**.

2. Phenylbutazone

It is a potent non-steroidal anti-inflammatory drug approved for horses. In humans, phenylbutazone has been associated with a variety of adverse drug reactions including **fatal bone marrow toxicities**. After USDA reports of a high incidence of phenylbutazone tissue residues in cull dairy cows, in 2003, CVM prohibited the use of this drug in female dairy cattle older than 20 months of age.

3. Chlorpromazine

It has been used as a tranquilizer. Its use has been restricted in food animals as they are **hepatotoxic and may cause orthostatic hypotension**.

4. Ronidazole

It has been as **antiprotozoal and antibacterial in livestock feed**. They are prohibited in food animals as they are **carcinogenic and embryotoxic.**

5. Colistin:

It has been used in against ***Enterobacteriaceae*** **infections**. They are restricted due to development of **antimicrobial resistance**.

The Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA) permits veterinarians to prescribe extra-label uses of certain approved new animal drugs and approved human drugs for animals under certain conditions. Under AMDUCA any extra-label use of an approved new animal or human drug must be by or on the lawful order of a veterinarian within the context of a veterinarian-client-patient relationship (VCPR).

RESTRICTED AND PROHIBITED DRUGS IN FOOD ANIMALS

GROUP I. Drugs with No Allowable Extra Label Uses in Any Food Producing Animal Species

- **Chloramphenicol** – due to **bone marrow suppression** and may lead to aplastic anaemia and it is genotoxic.
- **Clenbuterol**– due to its interference in **coagulation process** and impaired development of reproductive organs in animals, **doping effect in humans** (which is also banned by **IOC and WADA**).
- **Diethylstilbesterol (DES)**- due **cervico-vaginal cancer** in next generation animals.
- **Fluoroquinolone Class Antibiotics**– due to development of antimicrobial resistance.
- **Glycopeptides**– all agents, including **Vancomycin**– due to development of antimicrobial resistance.
- **Medicated Feeds**– due to development of antimicrobial resistance.
- **Nitroimidazoles** – all agents, including Dimetridazole, Ipronidazole, Metronidazole and others - due **to tumour production in rodent studies** and because of

evidence that associates extra-label use in food animals with potential human health problems, the entire class of compounds is prohibited from use in food animals.

- **Nitrofurans**– all agents, including Furazolidine, Nitrofurazone and others – due to **tumors in rodent studies**, and in 1991 the FDA withdrew approval for systemic animal nitrofuran products.

GROUP II. Drug Classes with Prohibited ELDU or with Restricted ELDU in Food Producing Animal Species

- **Adamantane & Neuraminidase Inhibitors:** Extra label use (ELDU) of these drugs is prohibited in poultry including chickens, turkeys and ducks in the United States.
- **Cephalosporins:** ELDU of all cephalosporin antibiotics, except Cephapirin, is restricted in the United States. ELDU restrictions differ for Major vs. Minor Food Animal Species as noted below:

  1) Major Food Animal Species (Cattle, Pigs, Chickens and Turkeys): ELDU is permissible only for therapeutic indications that are not included on the product label. However, ELDU of cephalosporin antibiotics is prohibited in all of the following situations:

  - The intended use of the product deviates from the approved dose, treatment duration, frequency or administration route on the product label.
  - The intended use of a product in an unapproved major species or animal production class.
  - The intended use of the product for the purpose of disease prevention.

  2) Minor Food Animal Species (all species that are not major species): ELDU of cephalosporin antimicrobial agents is permitted in these species.

- **Gentian Violet:** use is prohibited in food or feed of all food producing animal species- as it is carcinogenic.
- **Indexed Drugs:** ELDU of these drugs is prohibited in all food producing animals, with some exceptions for minor use animal species that are not used as food for humans or other animals.
- **Phenylbutazone**: all uses of this drug are strictly prohibited in

female dairy cattle greater than 20 months of age.

- **Sulfonamide–Class Antibiotics:** ELDU of all sulfonamides and potentiated sulfonamides is prohibited in adult lactating dairy cattle or dairy cattle greater than 20 months of age associated with increased tumor formation in laboratory rodents. Only labeled uses of approved sulfonamides are allowed. ELDU of sulfonamides in milking sheep and goats is discouraged but not prohibited.

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ROOT KNOT NEMATODE - AN EMERGING PATHOGEN IN PADDY

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Introduction

Rice is one of the most important cereal crop in the world, more than half of the world population forms as staple food. In India, rice is extensively grown and occupies about 23.3% of the gross cropped area of the country, covering about 43 million hectares of land (Food and Agriculture Organization of the United Nations 2018). In India rice contributes 43% of the total food grain production and 46% of the total cereal production. In India rice is grown in 43.91 million ha, the production level is 109.76 million tones and the productivity is about 2499.96 kg/ha (Agricultural Statistics at a glance, 2021). Plant diseases are one of the major limiting factors in the production of food crops and in attaining food security and food safety. These were caused by various biotic and abiotic factors contribute to the lower productivity of rice in India. Among biotic factors nematode infestation is considered an important factor responsible for upto 72% of yield loss (Khan *et al*. 2014 and Prasad, 2011) and also cause 5–20% yield decline in food crops, which may account to a net loss of 2–7% in crop-based food. Rice, wheat, and maize are most important food crops and are frequently attacked by plant nematodes (Mujeebur *et al*. 2020). Generally, the crop damage caused by nematodes remains hidden to farmers because of nonappearance of discernable symptoms. In addition to direct damage, nematodes aggravate the infection of soil borne pathogens or act as vector leading to development of disease complexes. Some of the most important nematode genera are Meloidogyne, Pratylenchus, Ditylenchus and Heterodera as these nematodes are widely distributed in agricultural fields and cause tremendous damage to food crops. The rice root-knot nematode, *M. graminicola* is widely distributed in upland, lowland,

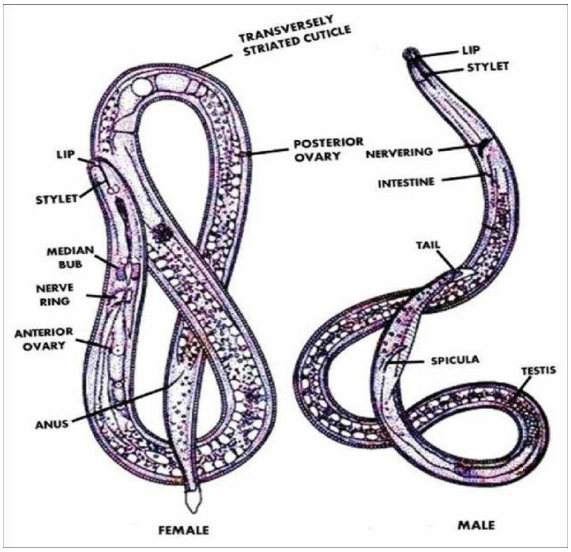
deepwater and irrigated rice growing areas of the world. To prevent yield losses caused by rice nematode, it is essential to know about symptoms, biology, technique to identify nematode and management of rice nematode.

Symptoms of the nematode damage

Rice root knot nematode **(***Meloidogyne graminicola*) develops Characteristic hook-like galls on roots, it impairs the absorption of water and minerals from the soil. As a result, leaves become chlorotic, newly emerged leaves appear distorted and crinkled along the margins, heavily infected plants flower and mature early, reduced tillering. Size of the ear head is reduced with partially filled grains (Bridge *et al*., 2005 and Kyndt *et al*., 2014). This causes death or drowning out of the plants leaving patches of open water in the flooded fields.

Description of Female nematode

Pearly white, globular to pear shaped with small neck, cuticle distinctly annulated but often marked with irregular punctations. Lip region smooth, anteriorly flattened, not distinctly set off from neck. Stylet slender and delicate, knobs rounded with posteriorly sloping anterior margins. Orifice of dorsal oesophageal gland 3.2 (2.8-3.9) µm behind stylet base. Excretory pore conspicuous, anterior to median oesophageal bulb, more than one stylet length posterior to stylet knobs and 7-16 annules behind lip region. Ovaries two, well developed, convoluted, filling body cavity and overlying the intestine, uterus with several eggs. Six large radially arranged, uninucleate rectal glands with prominent nuclei, surround the rectum. Posterior cuticular pattern dorso-ventrally oval, sometimes almost circular. Distance from anus to vulva about 2.5-3.0 times the distance between anus and level of phasmids.



Morphology of Female and Male root knot nematode

Description of Male nematode

Body cylindrical, vermiform, tapering more towards anterior than posterior extremity. Cuticle prominently annulated. Annules about 2.1-2.5 µm apart near mid-body. Lip region continuous with body or slightly offset by a constriction, nearly flat anteriorly, 3.5-4.0 µm high and 8.5-9.0 µm wide, consisting of a prominent labial annule followed by 1 or sometimes 2 wide post-labials. Stylet fairly strong with rounded posteriorly sloping knobs, 3.5-4.0 µm across, anterior conical part of stylet about 50% of the whole length. Isthmus, a narrow tube, encircled by nerve ring near middle, three oesophageal glands forming a compact lobe overlie intestine ventrally and ventro-laterally. Lateral fields 7.7 (6.2-9.5) µm wide or about one quarter of body-width, marked with 4 incisures in young and 8 in large and old specimens, near mid-body. Testis single, outstretched, sometimes reflexed anteriorly. Spicules arcuate or slightly bent ventrally near middle, 28.1 (27.4-29.1) µm long medially. Gubernaculum rod-shaped 6.1 (5.6-6.7) µm long and tail 11.1 (6.2-15.1) µm wide with smooth terminus. Phasmids small, postanal, located near middle of tail.

Second-stage juveniles

Body cylindrical, vermiform, tapering towards posterior extremity. Cuticle finely marked with distinct transverse striae, about 1 µm apart near mid-body. Lip region continuous with body, weakly sclerotized, marked with 3 faint post-labial annules. Stylet delicate with posteriorly sloping rounded knobs. Tail 70.9 (67.0-76.0) µm long, including the irregularly annulated posterior hyaline portion, which is 17.9 (14.0-21.2) µm long and 4-5 times as long as the anal body width. Tail terminus rounded, often slightly clavate.

Life cycle of the nematode

M. graminicola is the hidden enemy of a rice crop. It is soil borne and microscopic in nature, female nematodes and eggs inside rice root gall. It developed froman embryo through the first and second juvenile stages

within an eggshell. The infective second stage juvenile (J2s) hatches and infects at the elongation zone and then moves upward to the root tips where they invade the vascular cylinder to form a feeding site of three to ten cells, called a giant cell. Simultaneously, the surrounding cells start to divide to form a typical gall or root-knot. Male and female J3s become round and sedentary inside the gall and continuously molt to J4s and finally adults. *Meloidogyne graminicola* females commonly reproduce asexually through parthenogenesis. The newly hatched J2s can stay inside the gall or move intercellularly to establish a new giant cell within the same root. In rare cases, *Meloidogyne graminicola* reproduces through sexual reproduction in which adult males again back to a vermiform shape, while adult females keep their pear-shape. Adult males fertilize females and leave the root afterward. The life cycle of *Meloidogyne graminicola* can be completed in 25-28 days (Narasimhamurthy *et al*. 2016) under ideal environmental conditions. A single female can lay 500 to 1000 eggs during its lifetime (Bridge *et al*., 2005; Kyndt *et al*., 2014; Mantelin *et al*., 2017).

Table 1: Duration of different stages in life cycle of *M. graminicola* (Narasimhamurthy *et al*. 2017)

S. No	Life stages	Duration (Days)
1	Second stage juvenile (J2)	1-5
2	Third stage juvenile (J3)	6-8
3	Fourth stage juvenile (J4)	9-12
4	Adult male	23
5	Adult female	26
6	Total life cycle	25-28

i) Cultural methods:

Flooding

M. graminicola will survive normal flooding but damage to the crop can be avoided by raising rice seedlings in flooded soils thus preventing root invasion by the nematodes (Bridge and Page, 1982). Continuous flooding is highly effective in controlling *M. graminicola* in Vietnam.

Crop Rotation

Certain crops are resistant or poor hosts of *M. graminicola* and could be used in rotation to reduce nematode populations e.g. castor, cowpeaa, sweet potatoes, soyabeans, sunflower, sesame, onion, turnip, Phaseolus vulgaris, jute and okra (Rao *et al*., 1986). Long

rotations, greater than 12 months, will be needed to reduce *M. graminicola* soil populations to low levels. However, one weed, *Eclipta alba*, is toxic to M. *graminicola* and could be grown and incorporated into the field to kill the nematodes (Prasad and Rao, 1979).

Soil Amendments

The use of decaffeinated tea waste and water hyacinth compost as organic soil amendments has been suggested to control *M. graminicola* (Roy, 1976).

In addition to above mentioned control measures the following measures also can control the root knot nematode in rice crop.

ii) Physical methods

Soil solarization with 50 – 100µ clear polythene sheets for 3 weeks before preparation of fields.

iii) Chemical methods

Chemical management of *Meloidogyne graminicola* is common in Asia and various methods are used. Seeds can be treated with non-fumigant nematicides such as carbofuran, and seedling roots can be dipped in systemic non-fumigant chemicals such as oxamyl, phorate and carbofuran. Fumigation with chemicals such as 1, 3-dichloropropene can help to reduce the number of nematodes before planting (Dutta *et al*., 2012)

iv) Biological control

Different biological control agents such as beneficial fungi i.e., *Purpureocillium* sp. *Trichoderma harzianum*, *T. virens, Catenaria anguillulae*, and beneficial bacteria i.e., *Bacillus sp., Pseudomonas* sp. are potential biological control organisms of *Meloidogyne graminicola* (Pankaj *et al*., 2015; Mantellin *et al*., 2017; Bui *et al*, 2020)

v) Resistance

The majority of rice cultivars are susceptible to *M. graminicola*. However, there are a number of cultivars from India, Thailand and USA which are reported to be resistant to this nematode.

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SUCCESS STORY ON MANAGEMENT OF LITTLE GOURD FRUITFLY, *Bactrocera cucurbitae* - THE IPM WAY

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Introduction

Problem analysis of Panchmahal district of Gujarat, farmers are diversifying from traditional maize-pigeonpea system to vegetable crops. Under vegetables crops, cucurbits are cultivated in majority of area. The major cucurbit grown by farmers are little gourd. The farmers sold the little gourd in local as well as distant mandis/markets. During rainy season fruit fly is a major insect-pest that adversely affects the yield as well as quality of cucurbit. Farmers of the district use various insecticides to control this insect, which is not only harmful to the human health but also affect the environment adversely.

Plan implement and support: The Anand Agricultural University, Anand, Gujarat recommended economical management of fruit flies by Installation of Cue-lure impregnated wood blocks @ 16/ha at the initiation of the fruiting followed by spot application of poison bait made by mixing of Jaggery at 5% and dichlorvos 76% @ 5 ml/10 lt. in water (500 g Jaggery + dichlorvos 76% @ 5 ml/ 10 liter of water) @ 8 liters/ha in the form of coarse droplets undersides the foliage at weekly interval. The spots should be spaced at 7 m x 7 m distance. The traps should be placed or hung at the border of the pendal and just 1 foot below the foliage or vines. The ICAR-Krishi Vigyan Kendra, Panchmahal has demonstrated this technology by conducting Front Line demonstrations at farmers field during the year 2011-12, 2012-13 and 2013-14 at 36 farmers' fields. The farmers were also educated about the technology during on and off-campus training programmes conducted on production and protection of crop.

Intervention	Year	Area (ha)/ No.	No. of farmers
FLDs	2011-12	2	12
	2012-13	2	12
	2013-14	2	12
Trainings/meetings	2011-12	3	45
	2012-13	2	30
	2013-14	3	45
	2014-15	2	40
	2015-16	2	35
Advisory	2011-12	-	25
	2012-13	-	23
	2013-14	-	27
	2014-15	-	33
	2015-16	-	35

Output:

Due to intervention of KVK, Panchmahal, the farmers have adopted this innovation especially by those who are cultivating little gourd. The adoption of this innovation resulted in reduction of losses by about 30-40 per cent and the yields of the crops increased from 20-29 per cent. Further, the quality of produce has also improved. The net returns of the farmers have also increased as they are not spraying expensive insecticides frequently.

Table 1. Exploitable productivity & economics of little gourd production

Year	Yield (q/ha)	Cost of cultivation (`/ha)	Gross returns (`/ha)	Net returns (`/ha)	B:C ratio
2011-12	140.50	22000.00	70250.00	48250.00	3.19
2012-13	139.25	23500.00	76588.00	53087.50	3.26
2013-14	135.50	24000.00	74525.00	50525.00	3.11
2014-15	140.00	24500.00	77000.00	52500.00	3.14
2015-16	145.00	25000.00	79750.00	54750.00	3.19

Outcome: During the implementation of FLDs all the package and practices were used as per suggestion of KVK experts. The cost of cultivation, production,

gross return, net return and cost benefit ratio of various years are given in Table -1 and Fig.1.

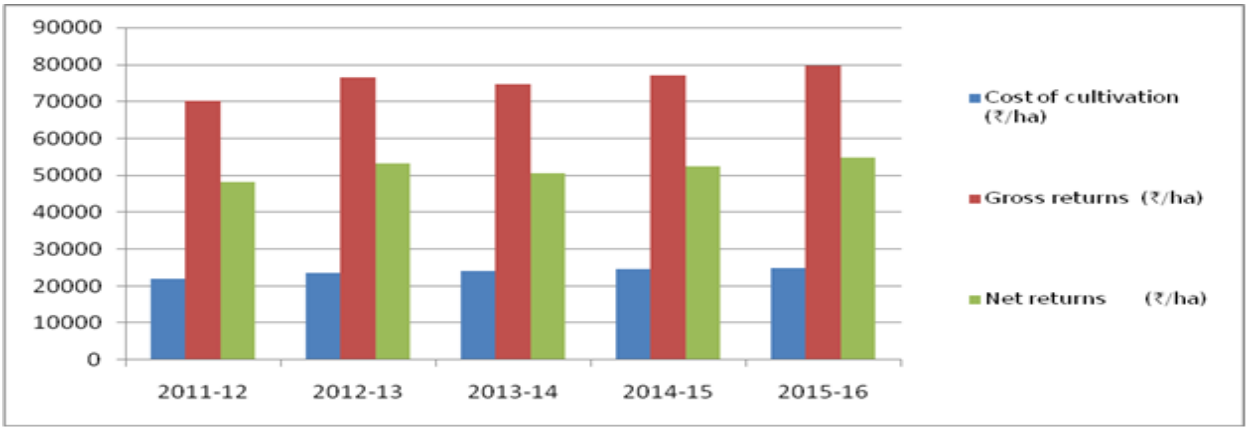

Fig 1. Cost of cultivation, gross return and net return of little gourd production

Little gourd fruits infested with *Bactrocera cucurbitae* (Coquillett)

KVK scientists interacting with farmers to demonstrating pheromone technology

Pheromone trap being installed in little gourd plot

Monitory and collection of dead fruit flies

Conclusion

The results of FLDs conducted on pheromone traps in different villages of Panchmahal district were encouraging and farmers has started demanding cue lure pheromone traps. The farmers are purchasing pheromone traps from various sources including private dealers. This technology has reduced pesticide and saved money of farmers. Therefore, this technology was adopted by about 60 per cent little gourd growers of the district for the management of fruit fly due to its obvious monitory benefit.

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THERAPEUTIC EDIBLE FLOWERS

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INTRODUCTION

Across the world, flowers signify many things. In some cultures, they represent abundance, purity, beauty, divinity, romance, wealth, fertility, enlightenment and even knowledge. Like fruits, vegetables, spices, leaves, and nuts, flowers too are part of nature's roster of nutrition providers to us. India's culinary history shows us that flowers have been used for therapeutic purposes, for balancing tastes, fragrance and even to improve the aesthetic appeal of a dish.

Flowers have been consumed for years in many cultures. Ancient Greek, Roman and Chinese used flowers for their medicinal properties and nutritional value. The fresh flowers were used for treatment of certain diseases, including open wounds. In aromatherapy rose, lavender, rosemary and passion flower are widely used. In ancient times, edible fresh flowers are considered and transported as fine spices. Flowers have been used for production of various types of cooked food viz., syrups, jellies, sauces, and different desserts. Flowers were included in the composition of products such as liquors, vinegars, teas and other beverages, honey, oils, candied flowers, ice cubes and salads. Flower petals were eaten most often fresh in salads or as garnishes, included in food the flowers can affect the sensory characteristics of food. They contribute to improve the colour, taste and aesthetic appearance of food. Rose, dandelion, viola, calendula and chamomile are the most common example of flowers, which are edible. In recent years the interest in the consumption of fresh flowers is renewed for several reasons, not least because consumers are more demanding in their choices of food. Edible flowers are becoming more popular due its usage in meals as a garnish or ingredients in salads, soups, entrees, desserts and drinks. The edible flowers reveal as pharmacological resource possessing the properties like

anti-anxiety, anti-cancer, anti-diabetic, anti-inflammatory, anti-oxidant, diuretic, anthelmintic, immunomodulatory, anti-microbial along with its effective dosage. It is known that antioxidants when present in the daily ration could prevent chronic diseases such as type 2 diabetes, cancer and cardiovascular and neuro degenerative disorders.

INDIAN ROSES

This flower needs no introduction. In India, the 'gulab' is used as a common flavouring in several desserts, and rosewater syrup is a necessary component of the sweet, gulab jamun. The petals themselves, carry a palpable floral sweetness and is also used across the Middle East. The roses in India commonly sighted in the form of gulkhand (a sweet preserve of rose petals from India) or a thick sweet jam like paste used in paan, kewra water which acts as a natural coolant; candied dried rose petals as a garnish on mithai for fragrance and even attar or native perfumes. The petals can be used in tea blends as well. While the fruits of the rose plants, known as rose hips have been made into jams and marmalades, the extract from the petals is often used in syrups. The Indian classic, Rooh Afza sharbat also uses an extract of rose as a flavouring. A great source of Vitamin C, the petals can even be dried and combined with other herbs for a refreshing sweet tea.

Benefits

Rose petals help the body maintain healthy cholesterol levels; rosewater reduces inflammation, soreness and is a natural coolant. It's a mild sedative, enhances the body's natural immunity, and promotes a healthy heart.

JASMINE

A popular pick for perfumes and oils, the flower's aroma also functions in scenting teas and sweet dishes like cakes, cookies, and other bakes. At home, you can dry and mix them in a bag of green tea leaves and watch them 'flower' or 'bloom' in a cup of hot water. In its dried form, one can also add these to salads and rice dishes for aroma and added health benefits.

Benefits

Jasmine tea lowers blood pressure, strengthens the immune system, and regulates the aging process. Known to control insomnia, aid weight loss, and control cholesterol levels, it is an energy booster and mood enhancer.

MORINGA FLOWERS

Moringa, or drumstick, is a popular vegetable in South India, where it frequently makes an appearance in sambar. All parts of the drumstick tree viz., leaves, buds, flowers, bark, fruit and root are edible. However, few know that the moringa flower, too, is packed full of flavours and is perfect for cooking. 'Drumstick flower', this trending superfood has finally started getting its due. The flowers can be steeped in boiling water for a calming tea, blended into a mild chutney, or can even be fried in oil for a crispy snack. The flowers are used in soups, salads, or fry them and add to dishes along with dals and lentils, in omelettes and seafood. But eat in moderation, as it can have a laxative effect. Moringa flowers can either be dried in the shade or in the oven under low temperature and stored to make tea. Steep the flowers in hot water for five minutes, to get a distinctive flavoured brew that is sweetened with honey or sugar. A handful of fresh drumstick flowers slightly sauted and added to dosa, adai and rotis helps enhance the taste.

Benefits

The flower has played protagonist in ancient medicine for decades considering the large amounts of fibre, magnesium, potassium and protein it provides. It's affordability and accessibility make it an excellent weapon to combat malnourishment; adds aroma, and helps to reduce muscle inflammation by restoring balance to the body. Drink when there is a hint of an approaching cold. It is supposed to boost the immune system and treat sore throats. It is said to help lactating mothers, reduce menstrual cramps and bloating. The flowers are rich in potassium and calcium and have been known as an effective cure for muscle spasms and tension.

TAMARIND FLOWER

Indigenous to Africa and long cultivated in India, tamarind's most common use has been of its pulp to add a signature sourness to lentil curries, chutneys, Indian stews and to make cooling drinks. Interestingly, the iconic Worcestershire sauce has tamarind being an essential part of the even the copyrighted recipe.

Benefits

The pale-yellow flower with red and purple veins is often found in a dried form and adds a tart sweetness to any food aiding digestion, excellent for insulin control, is diabetic-friendly and

for women who are prone to urinary infections.

BANANA FLOWER

Popular in South India, where it is known as vazhaipoo, the banana blossom's flavour is a milder version of a banana. It is rich in iron and fibre and is useful for building immunity against bacterial infections. It is extensively used in Malabar cuisine, where it is fried in coconut oil, along with spices. While cleaning the banana blossoms can be slightly cumbersome. Each blossom needs to be peeled and separated. The dishes made from it are incredibly healthy and tasty. Just remember that the flower turns brown quickly so peel the outer magenta layer only when ready to use or soak in lemon water.

Benefits

A powerful source of protein and vitamin C, it aids weight loss as it's high in fibre and provides a feeling of sustained satiety and is a natural mood-booster. It also reduces anxiety, encourages healthy gut bacteria, is rich in anti-ageing properties and free radicals a superfood all the way.

ROSELLE

This flower goes by plenty of names depending on where it is grown. Roselle in West Africa and Australia, while in India it goes by Ambadi in Maharashtra, Gongura in Andhra Pradesh, and Telangana and Chukor in Bengal. The primary taste profile it offers is a unique citric flavour with a hint of bitterness. The sorrel leaf (as it's referred to in popular culinary lingo) are added to salads and soups. In Andhra cooking, gongura is added to lentil curries and made into a popular dish of leaves and spices called gongura pachadi. At home, you use it to add a sweet-sour flavour to your fruity cakes, chutneys, and even rum-based drinks, as the newer mixologists across the country are doing. Jams, cooling drinks, and preserves are other common forms of giving this stunning flower an opportunity to show off its hue and flavour. However, the best way of savouring its health benefits is by infusing it in tea or sprinkling a dried version on top of your food.

Benefits

The winter superfood is a wonderful source of vitamins, minerals, and antioxidants; is low in calories, high in fiber, and aids weight loss. Its high in vitamin C, benefits both skin and hair, improves the elasticity and production of collagen, makes skin smoother, and reduces wrinkles when used in face packs. It boosts the immune system,

prevents anaemia, and balances the acid and alkaline ratio in the body. It is rich in vitamin C and perfect to prevent cough and cold. It is also said to prevent mouth ulcers and relieve heart burn. It also facilitates urination.

PAPAYA FLOWERS

It is well known that papaya leaves and the fruit itself are edible, but did you know that the entire plant has its own benefit even the flowers. Rich in antioxidants and vitamins A,C, and E, the flower has several health benefits including lowering cholesterol, improving appetite, and treating diabetes. The miniature white flowers are slightly bitter to taste, but can be squeezed with salt and washed under water in order to reduce the intensity of flavour, and used alongside common vegetables for a tasty dish. Papaya trees are commonly seen across the country; they are accessible and affordable and provide many forms of nutrition and livelihood to those living in the North East of India, mainly Manipur. Their flowers are used extensively in salads, cooked with potatoes and simmered with fish heads. Benefits: This fruit's tree has leaves that are known to decrease the effects of diabetes. Not many know that while the leaves are an age-old cure for dengue, so are the flowers. They are also known to be excellent for eradicating lung infections and liver-related concerns.

LOTUS FLOWERS

Our national flower, the lotus is also remarkably the most 'human' plant as it has the ability to regulate temperatures like any warm-blooded bodies. In various parts of India, the most widely used part of this plant is the root; in the south of the country the root is sliced and simply spiced to make for a tasty side dish, while in Kashmir– where it is called nadru and other North Indian regions it's used in richer gravies like rogan jhosh and yakhni. This revered flower's seed–a common sighting in Sindhi and Punjabi home pantries, is commonly called phool patasha or makhana and is slowly becoming the 'modern popcorn'.

Benefits

With many curative properties, it can help stop bleeding and cardiac complications when brewed in tea. The seeds are beneficial to the kidney, spleen and heart; helps cure restlessness, palpitations and insomnia. Additionally, full of potassium and protein, it makes for a delicious pre or post-gym snack.

ROSE

BANANA BLOSSOM

LOTUS FLOWERS

JASMINE

ROSELLE

HIBISCUS

PAPAYA FLOWER

MORINGA FLOWER

TAMARIND FLOWERS

Volume: 02 Issue No: 04

MALPRACTICES OF OXYTOCIN AND THE HEALTH EFFECTS OF HUMAN ANIMAL INTERACTION

Article ID: AG-V02-I04-18

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Oxytocin is a hormone secreted by hypothalamic nucleus and stored in posterior pituitary gland.

ROLE?

- Contributes 2nd stage of labour
- Milk ejection

Artificial drug of oxytocin (Syntocinon) administered I/M or I/V to

- Induce labour
- Increase force of contraction in labour
- Contract uterine muscles after delivery of placenta
- Control haemorrhage
- Stimulate milk ejection

Harmful Effects

- Humans face all the harmful effects of this drug
- Children are most susceptible to its effect (imbalanced hearing and weak eyesight)
- Exhaustion and loss of energy
- Pregnant ladies should avoid oxytocin adulterated milk
- Children may born with deformities and low resistance level
- Increase risk of postpartum haemorrhage
- Women may hypersensitive and it could inhibit breast feeding
- Young girls may attain early puberty

Malpractices

- Oxytocin is a scheduled H-drug that means it cannot be bought or sold without a prescription
- It is specially banned under the prevention of cruelty to animals act, 1960 section 12, and food and drug adulteration prevention act 1960

- But lack of enforcement is responsible for its widespread use.
- Oxytocin can be procured for less than 25 paisa from local shops and chemists
- A fact that cow may not become pregnant after giving birth to 3 calves in a row if she is being given Oxytocin continuously.
- Now recent malpractices are that farmers are using it for enlarging the size of vegetables (cucurbits, brinjal especially)

Effects on Milk Production

- Oxytocin (OT) administration to cattle for whole lactation resulted in increase in milk yield by 11.6%.
- 3% increase in milk yield, if used before and after milking

Effects on Milk Composition

- Oxytocin administration causes significant decrease in percent acidity, fat, protein, SNF, and total solids.
- Mineral composition also affected (increase in Cu, Mn and decrease in Mg, Fe, Zn)

Effects on Reproductive Health in Dairy Animal

Prolonged use of oxytocin causes fertility disorder like

- Poor oestrus signs,
- Reduced lactation period,
- Low conception rate,
- High embryonic mortality,
- Delayed puberty,
- Increased abortion rate,
- Shortened postpartum oestrus interval
- Calf death soon
- Ovarian follicular cyst
- Anoestrus
- Repeat breeders

Does milk from such cattle hurt humans?

- There is a little evidence that oxytocin injected into cows at low doses is secreted in milk.
- Whatever little oxytocin which was present in the milk did not survive intestinal digestion
- So, it is unlikely that humans would experience effects like cancer.

Oxytocin (exogenous/endogenous) establishes in minutes the desirable effects and

Metabolised to inactive products rapidly in body

- Irrespective of whether Oxytocin is ingested with milk or secreted into milk, it is degraded readily by gut enzymes.
- So, it doesn't reach circulation in biologically active forms.
- So there seems to be less harm/no harm in consumption of milk in humans.
- But Oxytocin has remarkable effects on milk quality, composition, reproductive health of dairy animal, so its use in dairy industry should be discouraged.

AgriGate Editorial Team

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