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COMMERCIAL CULTIVATION AND COLLECTION ASPECTS OF MEDICINAL AND AROMATIC PLANTS

Mangesh Uddalsing Taji[1], Sachin Dighole[2*]
[1]Student of Bachelor in Pharmacy, Dr. Babsaheb Ambedkar Technological University, Raigad, Lonere.
[2] Department of Pharmaceutics, Faculty of Pharmaceutics, Dr. Babsaheb Ambedkar Technological University, Raigad, Lonere
Corresponding Author: Sachin Dighol

❖ GENERAL PLANTS ASPECTS INVOLVED IN CULTIVATION OF MEDICINAL

1.Factors affecting the cultivation of crude drugs

A. Exogenous

Exogenous factors that affect the cultivation of medicinal plants include:

Temperature

Temperature is an important factor for the production of chemical constituents and the physical properties of plant material.

Rainfall

Rainfall is an essential factor, but it can also cause water-soluble substances to be lost from the leaves and roots of the plant.

Soil Nutrients

Long-term cultivation of a single medicinal plant can lead to an imbalance in the soil's nutrient levels.

Altitude

Altitude affects temperature, humidity, and vegetation patterns for medicinal plants.

B. Endogenous Factor

Endogenous factors in agriculture include:-

Farm Structure

The structure of the farm, including the tiller angle, which affects the plant's ability to capture light and resist disease and pests

Entrepreneur's Features

The characteristics of the entrepreneur, such as their skills and experience

Plant Growth Regulators

These include salicylic and jasmonic acids, and ethylene, which regulate plant cells under environmental stress
Other factors that can affect cultivation include:-

Manures

These include farm yard manure, poultry manures, castor seed cake, neem and karanj seed cakes, vermin compost, bone meal, fish meal, biogas slurry, and blood meal

Pests

These include fungi, viruses, insects, and weeds, as well as vertebrates like rabbits, monkeys, pigs, hares, squirrels, and deer, and invertebrates like crabs, snails, and mites

C. Mineral Supplement

- The analysis for several micro- and macro-elements in the plants indicated that these were present in all plant samples which are responsible for curing different types of diseases.
- A variety of factors have been attributed to the increasing public interest in herbal remedies.

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- some of which include the high cost and side effects of most modern medications
- In the present study, the highest percentage of Na was found in Acer pictum 45 µg/g and lowest in Urtica dioica 17 µg/g.
- In different plant species, elemental accumulation depends on various factors such as the type of soil, fertilization method, plant species, and environmental circumstances.
- The overall study indicated that medicinal plants are a significant source of mineral composition.

D. Nutrients

1. Nitrogen (N):is the main nutrient for strong, vigorous growth, good leaf color, and photosynthesis.
- Plants that are almost all leaf (such as lawn grasses) need plenty of nitrogen, so the first number in fertilizers for lawns is especially high because grass must continuously renew itself after mowing.
- The higher the number, the more nitrogen the fertilizer provides.

2. Phosphorous (P) :-promotes root development which helps strengthen plants.
- It also increases blooms on flowers and the ripening of seeds and fruit. Lots of phosphorous is great for bulbs, perennials, and newly planted trees and shrubs.
- They depend on strong roots, so fertilizers meant for these plants often have high middle numbers.

3. Potassium (K):- improves the overall health of plants.
- It helps them withstand very hot or cold weather, defend against diseases, helps fruit formation, photosynthesis, and the uptake of other nutrients.
- Potassium works along with Nitrogen so if you add nitrogen to the soil, it is important to add potassium at the same time.

❖ Secondary Nutrients

1. Calcium C:- is important for general plant vigor and promotes good growth of young roots and shoots.
- Calcium also helps to build cell walls.

2. Magnesium (Mg):- helps regulate uptake of other plant foods and aids in seed formation.
- As it is contained in Chlorophyll, it is also important in the dark green color of plants and for the ability of a plant to manufacture food from sunlight.

3. Sulfur (S):- helps maintain a dark green color while encouraging more vigorous plant growth.
- Sulfur is needed to manufacture Chlorophyll.

E. Soil and Soil Fertility

1. Soil
- Soil provides mechanical support, water and essential foods for the development of plant.
- It consists of air, water, mineral matter and organic matters. The plants are able to Determine their own soil pH range for their growth.
- Nitrogen containing soil has a great useful for raising the production of alkaloids.

2. Soil Fertility
- It is the capacity of soil to provide nutrients in adequate amounts and in balanced Proportion to plants.
- It is also diminished through leaching and erosion. Soil fertility can be maintained by Addition of animal manures, nitrogen fixing bacteria or by application of chemical.

F. Pest and Pest control

Pest is an undesired animal or plant which causes loss of cultivated plants. The different Types of pests infecting medicinal plants are as follows:-

1. Fungi/Viruses
2. Insect
3. Weeds
4. Non insect's pests.

- Different techniques are followed to achieve pest control effectively.
- These methods are discussed as follows: Mechanical Method, Agricultural Method, biological method and chemical method

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G. Plant Growth Regulators

- Plants require light, water, oxygen, minerals and other nutrients for their growth and development.
- Apart from these external requirements, plants also depend on certain organic compounds to signal, regulate and control the growth of plants.
- These are collectively called Plant Growth Regulators or Plant Growth Hormones.
- There are different types of Plant Growth Regulators, which are also referred to as phyto- hormones.

❖ Characteristics of Plant Growth Regulators

- They can accelerate as well as retard the rate of growth in plants.
- Plants growth hormones or plant growth regulators exhibit the following characteristics:
- Differentiation and elongation of cells.
- Formation of leaves, flowers, and stems.
- Wilting of leaves.
- Ripening of fruit.
- Seed dormancy, etc.

H. Genetic Manipulators

Techniques Other than Genetic manipulation

❖ Simple Selection:-

- The easiest method of plant genetic modification used by our nomadic ancestors and continuing today, is simple selection.
- That is, a genetically heterogeneous population of plants is inspected, and "superior" individuals-plants with the most desired traits, such as improved palatability and yield-are selected for continued propagation.

❖ Crossing

- Crossing occurs when a plant breeder takes pollen from one plant and brushes it onto the pistil of a sexually compatible plant, producing a hybrid that carries genes from both parents.
- When the hybrid progeny reaches flowering maturity, it also may be used as a parent.
- Plant breeders usually want to combine the useful features of two plants.

❖ Somatic Hybridization:-

- Recent advances in tissue-culture technologies have provided new opportunities for recombining genes from different plant sources.
- In somatic hybridization, a process also known as cell fusion, cells growing in a culture medium are stripped of their protective walls, usually using pectinase, cellulase, and hemicellulase enzymes.
- These stripped cells, called protoplasts, are pooled from different sources and, through the use of varied techniques such as electrical shock, are fused with one another.

I. Diseases management of medicinal and aromatic plant

❖ ALOE VERA (Aloe barbadensis Mill. = A. vera L.)

- Alternaria leaf spot (Causal organism- Alternaria alternata, A. brassicae) The symptoms appear as small, circular to oval dark brown necrotic
- Sunken spots on the leaves.
- Rust (Phakopsora pachyrhizi, Uromyces aloes)

The symptoms appear as small, pale yellow spots on leaves which Expand and brown
Anthracnose disease:- (Colletotrichum gloeosporioides)
The initial appearance of symptoms is small round to oval, darkgreen water-soaked which later become circular spots with tan to light brown center.

❖ **Post-Harvest Technology of medicinal and aromatic plants**

- **Harvesting**
- Harvesting is an important operation in cultivation technology, as it reflects uponEconomic aspects of the crude drugs.
- The harvesting of crude drugs depends upon the type of drug to be harvested and the Pharmacopeia standards which it needs to

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achieve.

- Harvesting can be done efficiently in every respect by the skilled workers.
- The underground drugs like roots, rhizomes, tubers, etc. are harvested by mechanical Devices, such as diggers or lifters.
- The tubers or roots are thoroughly washed in water to get of earthy-matter
- Example: Flowers, seeds and small fruits are harvested by a special device known as Seed stripper.

- **Drying**
- This processing includes several operations or treatments, depending upon the source of Crude drugs and its chemical nature.
- Drying consists of removal of sufficient moisture content of crude drugs, so as to Improve its quality and make it resistant to the growth of microorganisms.
- Drying inhibits partially enzymatic reactions. In certain drugs, some special methods Are required to be followed to attain specific standards.
- The slicing and cutting into smaller pieces are done to enhance drying.
- The slicing and cutting into smaller pieces are done to enhance drying, as in case of glycyrrhizir.
- The flowers are dried in shade so as to retain their color and volatile oil content.
- Methods of drying are Natural Drying. And Artificial Drying. In the Natural Drying There are so many methods Shed Drying, Direct sun Drying and Artificial Dryings are

- **Garbling**
- This process is desired when sand, dirt and foreign organic parts of the same plant, notConstituting drug are required to be removed.
- If the extraneous matter is permitted in crude Drugs, the quality of drug surfers and at Times, it does not pass pharmacopeia limit.

- **Packing**
- The morphological and chemical nature of drug, its ultimate use and effects of climatic Conditions during transportation and storage should be taken into consideration while Packing the drugs.

- The drug which very sensitive to moisture and also costly at the same time .

- Examples: Aloe is packed in goat skin.

- **Storage**
- Preservation of crude drugs needs sound knowledge of their physical and chemical Properties.
- All the drugs should be preserved in well closed and possibly in the filled container.
- They should be stored in the premises which are water proof, fire proof and rodent Proof.
- Temperature is also very important factor in preservation of the drugs, as it accelerates Several chemical reactions leading to decomposition of the constituent.

- **Current Good Agricultural Practices**

Good Agricultural Practice:-

- (GAP) is a set of standards for the safe and sustainable production of crops.
- It aims to Help farm owners maximize yields and minimizing production costs and environmental Impact.
- The various stages of processing which are included in Good Agricultural Practices are Described as follows:

1. Seeds and propagation material
2. Cultivation.
3. Soil and Fertilization.
4. Irrigation.
5. Crop maintenance.
6. Harvesting.
7. Primary processing.
8. Packaging.
9. Storage and transport.

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10. Staff requirements.
11. Documentation.
12. Quality Assurance.

- **Current Good Cultivation Practices**

Objectives At the end of this lecture, student will be able to

- Discuss the different guidelines for Current Good Agricultural Practices
- Cultivation of medicinal plants requires intensive care and management. The conditions and duration of cultivation required vary depending on the quality of medicinal plant materials required
- If no scientific published or documented cultivation data are available, traditional methods of cultivation should be followed, where feasible.
- Otherwise a method should be developed through research.
- Medicinal plant material should be collected during appropriate season or time period to ensure of best possible quality of both source material and finished products.
- It is well known that the quantitative concentration of biologically active constituent is varies with the stage of plant growth & development.
- Collected material should be placed in clean baskets, mesh bags, other well aerated contains.

- **Current good collection practices**

Drone Farming: -

- Using drones for crop surveillance can Drastically increase farm crop yields while minimizing the cost of walking the fields or airplane fly-over filming.
- Seeing the true health of your field in a color contrast allows you to see how much sunlight is being absorbed by the crop canopy.

Crop sensors

- This is taking variable rate technology to theNext level.
- Instead of making a prescription fertilizer map for a field before you go out to apply it, crop sensors tell application equipment how much to apply in real time.
- It's fairly new and pretty expensive, but there is huge potential here.

- **Conservation of Medicinal Plant**

❖ EX-SITU:-

- It means offsite conservation.
- It is conservation of species in the man-made habitats that imitate the natural habitats of Species.
- It its less dynamic as it involves man-made habitats.
- It provides protection against all hostile factors.
- It is suitable for animals that are not found in abundance.
- It is an ideal option in case of rapid decline in the y number of a species due to Environmental or any other reason.
- It can be used to conserve crops and their wild relatives.
- Examples include zoo, aquarium and botanical garden.
- It involves sampling, storage and transfer of target species from their natural habitats to Man-made habitats.

❖ IN-SITU:-

- It is the conservation of wild species in their natural habitats in order to maintain and Recover endangered species.
- It is more dynamic as it involves natural habitats of organisms.
- It provides protection to endangered species against predators.
- It is suitable for animals that are found in abundance.
- It is not suitable in the event of a rapid decline in the number of a species due to Environmental, genetic or any other factor.
- Wildlife and livestock conservation involve in-situ conservation.
- Successful in situ conservation depends on rules, regulations and potential compliance Of medicinal plants within growth habitats.
- Examples include national parks, wildlife sanctuaries, biospheres reserve etc.

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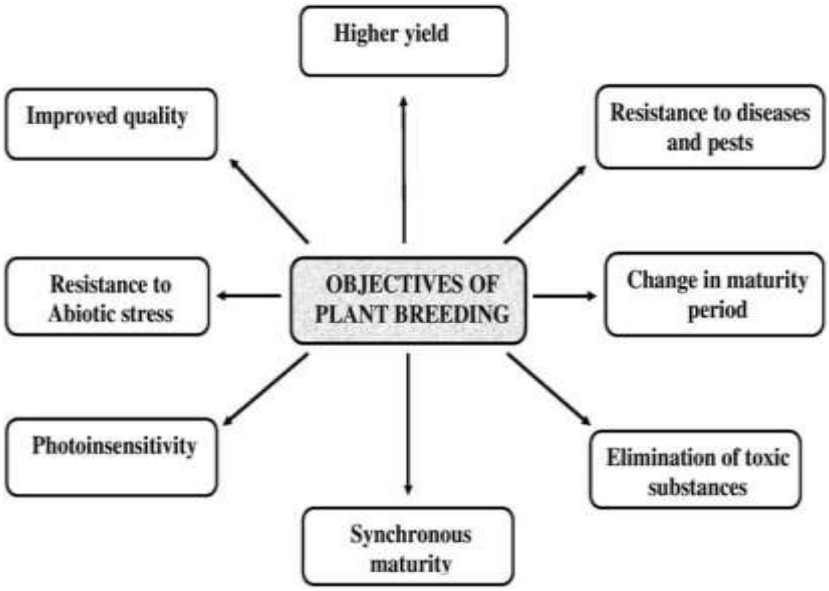
❖ METHODS OF IMPROVEMENT QUALITY OF CROPS AND THEIR APPLICATION

➢ Plant Breeding

- Plant breeding can be defined as an art and science and technology of improving the Genetic makeup of plants in relation to their economic use for mankind.
- Plant breeding is the art and science of changing the traits of plants in order to produce Desired characteristic.

Collection of Variability.

- Evaluation and Selection of Parents.
- Hybridization.
- Selection and Testing of Superior Recombinants.
- Testing Release and Commercialization of New Cultivar.



➢ Chemodemes

- Chemodemes ar regarded as a group of plants of a species which have identical morphological characters, but differ in their chemical nature.
- Due to this, chemodemes are considered as chemically separate groups within species, The observation of chemodemes can be confirmed only by growing different plants of a species in identical conditions, preferably from the seeds for many generations.
- By this way it shows variations either in type or contents of certain constituents, like the secondary metabolites of medicinal importance.
- The chemical characters of chemodemes are hereditary.
- Chemo demes are regarded as a group of plants of a species which have identical Morphological characters, but differ in their chemical nature.

➢ Hybridization

- Hybridization is the process of crossing two genetically different individuals to result in a third individual with a different, often preferred, set of traits.

- Plants of the same species cross easily and produce fertile progeny.
- Wide crosses are difficult to make and generally produce sterile progeny because of chromosome-pairing difficulties during meiosis.
- Hybridization of plants occurs in nature through various mechanisms.
- Some plants (such as the oil palm) are insect-pollinated, and others (such as maize, or corn) are Wind-pollinated.

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- Such plants are referred to as cross-pollinated plants.
- Natural hybridization has played a significant role in producing new genetic combinations and is the norm in cross-pollinated plants. It is a common way of generating genetic variability.
- Is the process through which hybrids are produced.The hybrid is an organism resulting from crossing Of two species or variants having at least one different character.

➢ **Type of Hybridization**
- Monohybrid- The hybrid is differ in one pair of character.
- Dihybrid- Differ in two pair of characters.
- Trihybrid, Tetrahybrid, Pentahybrid…….Polyhybrid.

➢ **Advantages**
- It gives a single variety with favorable characters.
- It can develop some new characters which were not present in their parents.

➢ **Mutation**
- Variation in characters of species is known an mutation.
- When a change occurs in genome of an individual which is not caused by environment and it may make Permanent evolutionary change, it is termed as Mutation.
- It is represented as a sudden change in Genotype causing qualitative and quantitative adulteration of genetic material.
- In other words, mutations arise due to change in DNA bases.

➢ **It is due to**

a. Environmental changes.
b. Changes in hereditary constitution.

➢ **Advantages**
- Mutation can cause morphological, anatomical and chemical changes which can increase Yield.

➢ **Disadvantages**
- The plant may become susceptible (sensitive) to climatic conditions and disease which can cause slow growth.

➢ **Polyploid :-**
- A condition where in the nucleus contains more than its normal complement of chromosomes is Known as polyploidy.
- Changes takes place due to increase in chromosome complement of nucleus like size of plant or organ and some physiological changes.

➢ **Typical effects of polyploidy**

a. Large flowers
b. Pollengrains and stomata.

➢ **Advantages of polyploidy:-**

1. Formation of new species.
2. Adaptability to various habitats.
3. Biochemical variation in plant that may increase amount of phytoconstituents.

❖ ROLE OF MEDICINAL PLANTS IN NATIONAL ECONOMY

➢ **Economic Growth Potential in herbal drugs and aromatic cosmetic products.:-**
- The cosmetic industry is a high-valued and evergreen multibillion dollar industry with more specialized and advanced products adding up every year.
- The major product categories in the cosmetic industry are skin care, hair care, perfumes, deodorants, toiletries, and make-up. Of these, skin care products top the list, accounting around 36 % of the global cosmetic market.
- Natural products, a treasure of medicinally active compounds are used for treating various skin ailments, infections, inflammation and as a protectant of UV irradiation and pollution.
- The hybrid of cosmetic and pharmaceutical compounds, known as cosmeceuticals, possesses therapeutic as well as beautification potential based on its key ingredients.
- Natural products are well regarded as a rich source of cosmeceuticals.

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- Different classes of natural compounds originating from animal, plant, and marine algal sources are placed under the category of high-valued cosmetic ingredients.
- The extraction of fatty acid components from botanicals and other natural sources opens up a big market in the cosmetic industry.

➢ **Future Economic Growth**

Our goals for this chapter include:

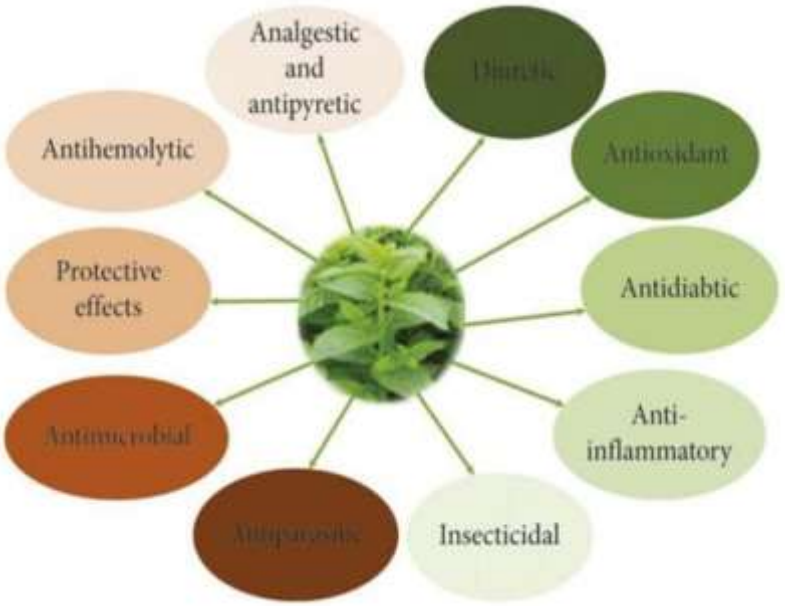
- Understanding economic growth in several way
- Utilizing and understanding the business cycle and cyclical and non-cyclical fluctuations
- Causes and definitions of all types of unemployment.
- Defining inflation, its causes
- Looking at and describing the ranges of inflation
- Knowing who is hurt and helped by inflation
- Understanding the relationship between unemployment and inflation



➢ **Development of Herbal medicine industry:-**

- Worldwide there is a growing demand for Ayurveda and other Traditional forms of medicine.
- In India, about 80% of the rural population uses medicinal herbs or indigenous systems of medicine.
- Herbs have been known since the era of civilization and are highly esteemed all over the world as a rich source of medicinal agents.
- The popularity of natural products is increasing day by day due to the facts that they are comparatively safe, less toxie, less side effects, easily available and affordable prices when compared to synthetic drugs.
- The herbal drug industry is a very fast growing sector in the international market.
- In India, various system of medicine like Ayurveda, Siddha, Unani, Homeopathy. Yoga & Naturopathy are being utilized for the Health care of people.

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➢ **Demand for Medicinal Plants and aromatic plants:-**

- To meet the requirements of expanding regional and international markets healthcare products and needs of growing populations.
- To meet the increasing demand for raw material needed for domestic consumption and for export.
- Over one and a half million practitioners of the Indian systems of medicine, in the oral and codified streams, use medicinal plants in preventive, promotive and curative applications.
- Several medicinal plants have been assessed as endangered. Vulnerable and threatened due to over harvesting in the wild.
- While the demand for medicinal plants is increasing, their survival in their natural habitats is under growing threat.
- Hence there is a need for conservation, cultivation, maintenance and assessment of M. plants for future use.

➢ **Trends in worldwide trade in medicinal plants:**

- Definition of Worldwide Trade: The worldwide tradeIs intergovernmental organization which regulateInternational trade related to medicinal plant.
- The term "Medicinal Plant" for worldwide trade specifies the plant having medicinal value.
- It proved as the plant having as therapeutic value.
- The main difficulty in analyzing the world trade inHerbal drug is extremely limited statistical data Available on production trade.
- No country publish their data & trade except USA provide the production center.

➢ **Main trading center**

The major broker and importer of herbs are established in major trading center as fallows:

1. New York (USA)
2. Hamburg (West Germany)
3. Marseilles & Paris (France)
4. London (UK)
5. Tokyo (Japan)
6. Rotterdam (Netherla

➢ **Export potential of Indian medicinal herbs:-**

- Medicinal and Aromatic plants have been used for a long time in India, the mention of their usage is as old as 10,000 years.
- There are about 2000 native plants with curative properties and 1300 species with properties of aroma and flavour.
- Now a days the Indian systems of Ayurvedic medicines have again emerged as a popular medical systems.
- India has one of the world's richest medicinal plant heritages.

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- According to study conducted by Exim Bank, there are 880 medicinal plant species that are involved both in national and international trade As per Exim Bank study 48 species are exported and about 42 imported Medicinal plants since the time immemorial have been used for the cure of human diseases.
- Presently about 80 percent of the Indian population is relying on indigenous medicines derived from medicinal plants.
- Rather, it has been a way of treatment in rural areas and it is also becoming popular among urban population in the form of Ayurveda. Sidha and Naturopaty.

➢ **Indian Medicinal plants used in aroma therapy:-**

- Aromatherapy is used to alleviate symptoms of headaches, insomnia, stress and digestive problems.
- Aromatherapy is the use of aromatic plant oils, including essential oils, for psychological and physical wellbeing.
- Aromatherapy uses plant materials and aromatic plant oils, including essential oils, and other aromatic compounds for the purpose of altering one's mood, cognitive, psychological or physical well-being. It can be offered as a complementary therapy or, more controversially, as form of alternative medicine.

➢ **Classification of aromatherapy:-**

- Cosmetic aromatherapy
- Massage aromatherapy
- Medical aromatherapy
- Olfactory aromatherapy
- Psycho-aromatherapy

➢ **Spices and there export:-**

- Spices: aromatic and pungent products of tropical plants, properties based on essential oils which are oily benzene or terpene derivatives, vaporizing and flammable.
- Herbs: small temperate plants used for aromatic constituents
- Incenses: plant substances that release fragrances when burned
- India is the largest producer and exporter of spices in the world.
- India with varied climate and soil is the natural home of spices. No country in the world grows as many varieties of spices as India.
- Although different spices are produced in different countries of the world, India has the privilege of producing all types of spices.
- Within India, Kerala is the largest producer of leading spices like pepper and cardamom.

➢ OBJECTIVES OF THE STUDY

- To trace the origin and growth of spices export from India.
- To assess the performance of spices export from India.
- To study the production and prospects of spices export in India.

❖ PATANTING AND REGULATORY REQUIRMENT OF HERBAL DRUGS

➢ **Indian and International patent laws:-**

- **Patent law in INDIA**
- It states that an invention relating to a product or a process that is new, involving inventive steps and capable of industrial application can be patented in INDIA.
- The India Patent Act 1970 defines an invention as follows:
- Invention means a new product or process involving an inventive step and capable of industrial application.
- Any product or process will be deemed to be an invention if it is novel, non-obvious, involves an inventive step and has industrial application.
- An invention should be novel, this means that such invention should not have existed previously.

➢ INTERNATIONAL PATENT LAWS

- The Patent Cooperation Treaty (PCT) is an international treaty and provides the possibility to file one single patent application (an "international" patent application) that has the same effect as a national patent application in more than 120 States, instead of filing multiple national or regional patent applications.

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- The European Patent Convention (EPC) is an international treaty between European countries.

➢ **Filling a patent:-**

- A patent application can be made on prescribed application form. This can be obtained From Patent office; the applicant has to furnish the following information. Title, name, Address and nationality of inventor.
- Specification: Giving the details of invention. Claims: Definition and scope of invention.

➢ **Farmer Right**

- Farmers Right to register traditional varieties Developed by farmers.
- Farmers Right on seed – have right to use , save , exchange , share and sell seeds.
- Farmers Right for benefit sharing of new variety developed by Farmers.
- Farmers Right to get compensation for loss cause by registered Variety.
- Farmers Right for seeds of registered varieties .
- Farmers Right for receiving free service like registration fee, test fee, etc.
- Farmers Right for protection against innocent violation.

➢ **Breeders Right**

Also known as plant breeders right (PBR) .

- Designed to protect new plant varieties.
- Breeder of new variety of plant which gives exclusive rights to control propagating.
- Material i.e. seed, cutting , division , tissue culture, etc.
- According to this right …. Anyone who creates novel plant variety can obtain exclusive Rights .
- Breeders can become an exclusive marketer on varietyto get exclusive rights , variety Must be new, distinct and uniform.

➢ **Bioprospecting and Biopiracy**

➢ **Bioprospecting**

- Bioprospecting is the process of discovery and commercialization of new products based on biological resources.
- Bioprospecting, also known as biodiversity prospecting, is the exploration of biological material for commercially valuable genetic and biochemical properties.

➢ **Biopiracy**

- The term biopiracy was coined by Pat Mooney, (co-founder of RAFI (Rural Advancement Foundation International)), to describe a practice in which indigenous knowledge of nature, originating with indigenous peoples, is used by others for profit, without authorization or compensation to the indigenous people themselves.
- From the root words “bio” and “piracy”, biopiracy literally means “the patenting of life.
- When biodiversity or related knowledge is collected without permission from the owners of these resources and then patented, it is known as biopiracy.

➢ **TYPES OF BIOPIRACY**

Raditional Knowledge B Traditional Knowledge Biopiracy:

- Genetic resources can be defined as “any living material containing functional units of heredity”.

Genetic Resource Biopiracy:-

- Traditional knowledge refer to indigenous communities, comprising “knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyle”.
- Traditional knowledge is based on experience and is usually passed on through generations.

❖ CASE STUDIES OF PRODUCT OF SOME IMPORTANT MEDICINSAL & AROMATIC PLANT

❖ Ashwagandha:-

- Common Name : Winter cherry, Indian Ginseng, Asgandh.
- Botanical Name : Withania somnifera.
- Family : Solanaceae.
- Origin : East Asia & Africa.

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- Economic Part : Root.

Name ashwagandha is made of two words i.e. Ashwa means horse and gandha mean smell Reflecting that roots have horse like odour.

- **Economic part:** Roots, bark, seed and leaves.
- **Chemical constituent:** The major alkaloid present in roots is Withanine.
- **Uses:**

- It is considered as wonder herb with multiple medicinal properties. It has many Uses such as:
- Roots are used for curing bronchitis, stomach-aches, lung inflammation and skin Diseases.
- Leaf paste and root paste are used to relieve joint pain and inflammation.
- The leaves are used for providing comfort during eye-diseases.
- Seeds are diuretic in nature.



- **Distribution:-** It is found throughout the drier parts of India particularly in states of M.P., Gujrat, Rajasthan, Western UP, Punjab, Haryana, Maharashtra, Karnataka, Kerala and Himalaya Upto height of 1500m. In M.P., about 4000-5000 ha of land is under cultivation of Ashwagandha. The estimated production of its roots in India is 1500 MT, while the annual Requirement is about 7000 t, necessitating increase in its cultivation and improving Productivity. Ashwagandha has been identified by NMPB as one of the thirty-two Medicinal plants and is one of the top ten traded herbs. It is cultivated under rainfed Condition in marginal soils by small and marginal farmers.
- **Morphology:-** It is a small, erect, branched, woody shrub that grows up to 1.50 M tall. Roots are fleshy, Tapering, whitish brown. Leaves are ovate and flowers are greenish. The mature fruits are orange red barrier.

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Fig: Ashwagandha Plant (Vegetative stage, Fresh fruit, Dried root and Dried fruits)

- **Climate:-** It is grown in sub-tropical, low rainfall regions. It is grown as long duration, winter annual (240 days) on marginal lands. Late winter shower favour its good root development. The Sub-tropical areas receiving 500 to 750 mm rainfall are suitable. It requires relatively dry Season during its growing period. Temperature between 20°C to 35°C is most suitable for its cultivation.
- **Soil:-** It can grow well in wide range of soil types. But it prefers well drained, medium red and Black soil with good drainage. The soil should have pH range of 7.5 to 8.0. Black or heavy Soils having good drainage are also suitable for its cultivation.
- **Propagation:-** It is raised from seeds. Seeds do not have dormancy. The seeds harvested from previous Season having good quality should be used.

Showing method :- Seeds are generally sown directly in field during August end. Line to line method is Preferred as it increases root production and helps in performing intercultural operations Smoothly. For better germination of seeds, the seeds may be soaked in 500 ppm of Gibberellic acid overnight, washed and then treated Dithane M-45 (Indofil M-45) at the rate Of 3 g/kg seed to protect the seedlings from the seed borne diseases. The seeds are usually Sown 1-3 cm deep. Seeds should be covered with light soil. Line to line distance of 30 cm And plant to plant distance of 10 cm should be maintained.



Fig.: Ashwagandha Seed

- **Land preparation:-** In Ashwagandha, roots are the major economic part. Thus, land should be prepared in such a Way that it should not have any hindrance in the development of roots and get more length And girth for better quality. The land was ploughed once with MB plough and harrowed twice to bring the soil to fine tilth after receiving pre- monsoon rain.
- **Manures and fertilizers:-** Optimum crop nutrition should be ensured as excess or deficit of any essential plant nutrient May decline the production as well as quality of the produce. Soil testing should be done Before applying the nutrients. Use of organic manures preferred over inorganic sources of Nutrients for growing of ashwagandha. Organic manures like, farm yard manure,

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Vermicompost, green manure etc. may be used as per requirement of the crop. Generally, its Fertilizer requirement is very low. Farmers rarely give inorganic fertilizers, but crop responds Well to application of 10 t FYM or one tonne vermicompost and 20:40:20 NPK kg/ha.

- **Irrigation:-** Ashwagandha is usually grown as rain fed crop where irrigation facilities are not available. However, for irrigated crop there should be access to a clean and reliable source of good Quality irrigation water. Excessive rainfall or water is harmful for this crop and not require Irrigation, if monsoon is well distributed throughout the growing season. However, one or Two life-saving irrigations can be given if required. Under irrigated conditions, the crop can Be irrigated once in 15 days depending on soil type. Organic mulches such as wheat straw or Ashwagandha straw of previous crop should be spread in between the rows to conserve the Soil moisture, facilitate better water infiltration during excess rains and control weed.
- **Harvesting:-** Harvesting should be done at the right stage to ensure maximum levels of active ingredients And better quality. Ashwagandha plants start flowering and bearing fruits from December Onwards. The crop is ready for harvest in January-March at 150 to 180 days after sowing. The maturity of crop is judged when leaves start drying and berries become yellow red. Root Size, root and shoot biomass and alkaloid content were found maximum in 180 days crop which should be considered as best harvesting time for ashwagandha.
  Ashwagandha should Be harvested in the dry weather and not in rain or in early morning when there is dew on the Ground. Harvesting is done by uprooting the whole plant without damaging the roots.
- **Post-harvest handling:-** The roots are separated by cutting the stem 1 to 2 cm above the ground, the roots are washed, Cut into 7 to 10 cm small pieces and dried in sun or shade. Roots should be dried to 10 – 12 % moisture content. Roots can be graded in to 3-4 grades as follows. : l. A grade root: Root pieces up to 7cm length and diameter 1.0 – 1.5 cm, solid, bright and pure white. 2. B grade root: Root pieces up to 5 cm length and diameter 1 cm, bright and white. 3. C grade root: Root pieces up to 3-4 cm length, diameter less than 1 cm, solid, side Branches. 4. Lower Grade: Small root pieces, semi-solid, very thick, yellowish, and chopped.
- **Yield :-** On an average from one-hectare crop under commercial cultivation, approximately 6-8 Quintals of dried roots and 50-75 kg seeds can be obtained. Cultivation of one hectare Ashwagandha crop may cost 10,000/- and gives return of 30,000 per hectare. However, it Depends on the demand and supply at a given time in the market.
- **Marketing and export:-** The Neemuch and Mandsaur markets of Madhya Pradesh are popular world over for Ashwagandha.
- **Periwinkle:-** Common Name : Periwinkle, Sadabahar, Sada phuli Botanical Name : Catharanthus roseus
  Family : Apocyanaceae Origin : West indies
  Economic Part : Leaves, seeds, roots, flowers
- **Importance:-** Periwinkle is a perennial ornamental herb found throughout India on waste lands and sandy Tracts. It has medicinal importance owing to the presence of indole alkaloids raubasin (ajmalicine) and serpentine in its root which have anti-fibrillic and hypertensive properties. The leaves contain two alkaloids viz., Vinblastine and Vincristine which form the Constituents of patented cancer drugs and vincristine alkaloids are distributed in different Parts of the plant but the roots .
- **Uses :-**
  1. Leaves used in curing blood cancer
  2. Leaves useful in treating menstrual disorders, diabetes mellitus.
  3. Decoction of leaves & roots active on hypertension.
  4. Roots control high blood pressure.
- **Origin and distribution:-** The plant is native of Madagascar and from there, it has spread To India, Indonesia, IndoChina, Philippines, South Africa, Israel, USA and other parts of the world. In India, it is Being grown in Tamil Nadu, Karnataka, Andhra Pradesh, Madhya Pradesh, Gujarat and Assam in an area of about 3000 ha. The USA is the world's largest user of this plant as raw Material. A single firm which has the patent to manufacture Vinblastine and Vincristine Sulphate has been consuming more than 1000 t of leaves annually. West Germany, Italy, Netherlands and the UK are interested in the roots. The total demand from these countries is More than 1000t of roots annually.
- **Botany:-** It is a perennial herb, often grows in garden for its pink and white flowers which bloom Throughout the year. It bears flexible long branches with simple opposite leaves. Flowers 3 In cymes, axillary and terminal clusters. Fruit is a cylindrical follicle with many black seeds.

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- **Climate:-** The distribution of the plant shows that there is no specificity in its climatic requirements. It Comes up well in tropical and subtropical areas. However, the growth in tropical areas is Better than in the subtropical areas, where its growth is slow due to the low temperature in Winter. It can be successfully grown up to an elevation of 1300 m above sea level. A well Distributed rainfall of 100 cm or more is ideal for raising this crop on commercial scale under Rain-fed conditions.
- **Soil:-** The crop is hardy and grows well on a wide variety of soils, except those which are alkaline Or waterlogged. Deep sandy loam to loam soils of medium fertility are preferred for its large Scale cultivation because of better development of roots and also easy to collect at harvest Time. pH should be upto 8.5.
- **Propagation:-** The plants can either be propagated by seeds or vegetatively through cuttings. Since plants Propagated by cuttings flower earlier than the plants from seeds, it is recommended that for Drug production the plants should be grown from seeds and for seed production from Cuttings.
- **Propagation by seeds:-** Fresh seeds collected a few months in advance are preferred for sowing as they lose viability On long storage. The seeds can either be directly sown in the field or a nursery can be raised And the seedlings are transplanted.
- **Vegetative propagation :-** To raise plants by this method, soft wood cuttings obtained from the lateral shoots have Proved better than either hard or semi hard wood cuttings. Cuttings of about 10-15 cm length With a minimum of 5-6 nodes are ideal and result in about 90% rooting. Soaking the cuttings Overnight in NAA solution of 25 or 50 ppm concentration has been found to further improve Rooting to the extent of 96%. This method can be profitably used for multiplying the clones Which have high alkaloid content and also where seed alone is to be produced.
- **Types and varieties:-** Three variants in periwinkle are there which are with (i) rose purple flowers (roseus), (ii) White flowers (alba) and (iii) white flowers with a rose purple spot in the centre (Ocilatta). The first type is being cultivated because of its higher alkaloid content. Recently, two white Flowered varieties named “Nirmal” and “Dhawal” have been released by the CIMAP, Luck now, which although equal in active principles are reported to yield a higher biomass.
- **Manures and fertilizers:-** FYM is applied at the rate of 10 – 15 t/ha to obtain good growth and yield. If irrigation is Available, green manure crops can be raised and ploughed into the field at the time of Flowering. In case organic manure is not applied it is advisable to apply a basal dose of 20 kg N, 30 kg P2O5 and 30 kg of K2O per hectare per year. In addition, a top dressing with 20 kg Nitrogen can be given in two equal split doses during the season.
- **Irrigation:-** In places where rainfall is evenly distributed throughout the year, the plants do not require Any irrigation. However, in areas where rainfall is restricted to a few months in a particular Period, about 4-5 irrigations will help the plants to give optimum yield.
- **Weed control :-** The crop requires two weeding in the initial stages of its growth. The first weeding may be Done after about 60 days of sowing and the second at 120 days of sowing. Mulching the field With cut grass or rice straw will also minimize the weed growth.
- **Harvesting and processing:-** Leaves, stem and seeds: For leaves, leaf stripping twice, first after 6 months and the Second after 9 months of sowing can be taken. A third leaf stripping is also obtained when The whole plant is harvested. After the plant is harvested, it is dried in the shade.Roots: The crop is harvested 12 months of sowing. The plants are cut about 7.5 cm above The ground level and dried for the stem, leaves and seeds. The field is then copiously Irrigated and when it reaches proper condition for digging, it is ploughed and the roots are Collected. The roots are washed well and dried in the shade. For seeds, it has to be Collected from matured pods 2 to 3 months before the harvest of the whole plant. The Aerial part of the plant between 7.5cm

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and about 25 cm above the ground level is taken as The stem for the purpose of marketing.

- **Yield:-**Under irrigated conditions, about 4t/ha of leaves, 1.5t/ha of stem and 1.5t/ha of roots, on air Dried basis may be obtained. Whereas, under rain-fed conditions, the yield will be about 2 t/ha of leaves and 0.75t/ha each of stem and roots on air dried basis. The total alkaloid content in the leaf varies from 0.15 to 1.34 % of which the average content of Vinblastine is 0.002% while that of Vincristine is 0.005%.

CONCLUSION

There is an urgent need to adopt scientific measure for their cultivation, long term Preservation, protection and sustainable utilization of medicinal and aromatic plants. Further, the development program me on medicinal and aromatic plants is required to be Monitored by quality analysis of the produce in order to ensure materials of uniform Quality in term of alkaloid, essential oil and other chemical constitution for which these Plants are valuable in the market.

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