

## Medicinal Plants

This section will give you detailed and exhaustive information about the Medicinal and Aromatic Plants topic you have selected. The information is categorised into various subheads. Depending on the nature of the information you require, just click on the relevant link. This will open out a set of sub-links to further narrow down your selection.

For example 'Introduction' Medicinal plants section contains a list of sub-links that give you information on a whole host topics concerning that topic, like :  
Introduction, Importance, Systems of medicine, Utilization of medicinal plants.

### Introduction to Medicinal plants

- Conservation of natural resources and the capability to utilize them in sustained manner are essential for the well being and continued survival of man.
- Under the duress of over exploration and habitat degradation a number of wild plants are essentially facing a constant threat of extinction.
- Out of the 60,000 plant species that are listed as threatened of extinction, over 20,000 (or more) are from India alone.
- The botanical survey of India has prepared a provisional list of threatened plants which includes a large number wild (or) wild relatives of food, horticultural, medicinal and aromatic plants.
- India is endowed with a unique wealth of biota which include a large number of medicinal and aromatic plants.
- Many of these plants are rare and endemic and found only in wild sources.
- The population explosion coupled with the improved standard of living led to ruthless exploitation, resulting in the imminent danger of extinction of these plants.
- Most of these wild medicinal and aromatic plants are highly habitat specific, found only in forests and occupying highly specialized ecological niche with restricted distribution.
- There are neither biological informations nor adequate knowledge of casual factors that led to their rarity in the habitat.
- There is however, now an urgent need to evolve a sound strategy for the management and conservation of these plants on a long term basis.
- To evolve suitable strategies for conservation (or) the domestication/cultivation of medicinal plants, it is very essential to study the complete biological and ecological back ground of these species.
- Under domestication outside their normal ecological range (or) under the distributed eco-system conditions many of the wild medicinal and aromatic plants tend to behave differently.
- In some cases it becomes difficult to grow them (or) it may not even survive.
- In certain other cases if survives and grows but may not be producing the desired traits.
- A through understanding on their reproductive and growth biology as well as identification of the biological and ecological constraints leading to their reduced fitness, restricted distribution (or) even extinction etc., is therefore, necessary.

- An understanding of the biological and ecological back ground of the species in their normal habitat is also essential to understand their conservation biology as well as to predict their behaviour under artificial cultivation.

Strategies for conservation of medicinal plants:

- The conservation of the wild medicinal plants or any other such threatened species can be tackled by scientific techniques as well as social actions.
- There are basically two scientific techniques of conservation of genetic diversity of these plants.
- They are the in situ and ex situ method of conservation.

In Situ conservation:

- It is only in nature that plant diversity at the genetic, species and eco-system level can be conserved on long-term basis.
- Unless plant populations are conserved in the wild, that is in natural habitats, in viable breeding populations, they run the risk of extinction.
- It is necessary to conserve in distinct, representative biogeographic zones inter and intraspecific genetic variation.

Current status:

- In Karnataka, Kerala and Tamil nadu and more recently in Maharashtra the forest department in collaboration with FRUHT (Foundation for Rural Revitalization of Local Health Tradition) have established a network of 33 "Medicinal Plants Conservation Areas" (MPCAs) across the entire altitudinal range of south India.
- Each of these reserves is around 200 ha in size.

Regulation and wild collection:

- Regulating the harvest of medicinal plants from the wild for commercial purposes.
- Particularly those species whose harvest inevitably involves destructive collection.
- Local communities can develop a stake in sustainable harvesting of medicinal plants from the forest and village, district and state level co-operative are set up to manage collection, storage and marketing.

Current status:

- LAMP societies as they function at present neither benefit the primary tribal collectors nor provides adequate powers (or) accountability of the LAMPs with regard to protection and management of forests.
- The marketing function of LAMPs is also weak, so that collectors do not get remunerative prices through LAMP sales.

## EX situ conservation

### A. Ethno-medicinal plant gardens:

- Creation of a network of regional and sub-regional ethno-medicinal plant gardens which should contain accessions of all the medicinal plants known to the various ethnic communities in different regions of India.
- This chain of gardens will act as regional repositories of our cultural and ethno-medicinal history and embody the living traditions of our society's knowledge of medicinal plants.

#### Current status:

- There are estimated to be around 50 such gardens in the country ranging from acre to 40 acres some of them were set up by an All India Health Network.
- More recently a network of 15 such gardens have been set up in 3 states of South India with the initiative of FRLHT. One of the gardens is located in TBGRI, (Tropical botanical garden research institute) Palode at Thiruvananthapuram.

### B. Gene banks:

- While it is known that the largest proportion of local bio-diversity in all our ecosystem is used for medicinal purposes, very little is known about their conservation status in the wild.
- What is likely is that a large number of medicinal plant species are under various degrees of threat.
- The precautionary principles would suggest that an immediate and country-wide exercise be taken up to deposit seeds of wild medicinal plants with a first priority to known Red listed species and endemic species.

#### Current status:

- The department of bio-technology, Government of India has recently taken the initiative to establish 3 gene banks in the country.
- One is with ICAR at the NBPGR (National Bureau of plant genetic Resources) Campus, the second is with CIMAPs, (Central Institute of Medicinal and Aromatic plants) Lucknow and the third with TBFRI in Thiruvananthapuram.

### C. Nursery network:

- The most urgent and primary task in order to ensure immediate availability of plants and planting materials to various user groups is to promote a nation wide network of medicinal plant nurseries, which will multiply all the regional specific plants that are used in the current practice of traditional medicine.
- These nurseries should become the primary sources of supply of plants and seed

material that can be subsequently multiplied by the various users.

Current status:

- Planting material for 40 odd species of medicinal and aromatic plants is reportedly available in the ICAR and CSIR (CIMAP) network.
- In South India FRLHT has recently set up a network of 55 supply nurseries.

D. Cultivation:

- Figures projecting demand and trade in medicinal plant species globally indicate a step upward trend in the near future.
- One estimate puts the figure of world trade in medicinal plants and related products at US \$ 5 trillion by A.D. 2050 (world bank report , 1996).
- The demand so far has been met mainly from wild sources.
- This can't go on for much longer; policy intervention is urgently needed to encourage and facilitate investments into commercial cultivation of medicinal plants.
- Cultivation of medicinal plants however, is inversely linked to prevalence of easy and cheap collection from the wild, lack of regulation in trade, cornering of the profits from wild collection by a vast network of traders and middlemen and absence of industry's interest in providing buy-back guarantees to growers.

Current status:

- In the Govt. sector agro-technology of 40 odd species has been developed by ICAR - Agricultural University System and CSIR (CIMAOs & RRL, Jammu and Jorhat).
- In recent years industries like Dabur, Zandu, Indian Herbs, Arya Vaidya Shala, and Arya Vaidya Pharmacy and others have made some symbolic efforts to initiate cultivation.
- Since 1984 NABARD (National Bank of Agricultural and Rural Development) has formulated schemes for financing cultivation and processing of medicinal plants.

E. Community based enterprises:

- The income generated by the traditional medicine industry benefits small section of the society.
- A strong case exists for promotion of community level enterprises for value addition to medicinal plants through simple, on site techniques like drying, cleaning, crushing, powdering, grading, packaging etc.
- This will also increase the stake of rural communities in conservation and change the skewed nature of income distribution of the industry.

Current status:

- Three community based enterprises are known in south India, one in Gandhigram

Trust, (Dindigul), Preemade development Society (Peermade) Kerala and the third by VGKK in B.R.Hills, Mysore.



## Importance of Medicinal plants

### Important Medicinal Plants and their active constituents

Plant	Active principle	Pharmacological activity
1 <i>Rauwolfia serpentina</i>	Reserpine	Hypotensive
2 <i>Catharanthus roseus</i>	Ajmalicine	Vasodilator
	Vinblastine	Anticancer
	Vincristine	Anticancer
3 <i>Cassia angustifolia</i> , <i>Cassia acutifolia</i>	Sennosides	Laxative
4 <i>Plantago ovata</i>	Psyllium mucilage	laxative
5 <i>Glycyrrhiza glabra</i>	Glycyrrhizic acid	Antiinflammatory
6 <i>Berberis sp.</i>	Berberin	Antidiarrhoeal
7 <i>Digitalis lanata</i>	Digitoxin Lanatoside	Cardiotonic
8 <i>Taxus baccata</i>	Taxol	Anticancer
9 <i>Podophyllum emodi</i>	Podophyllotoxin Etoposide Tenoposide	Anticancer
10 <i>Datura species</i> , <i>Hyocymus musticus</i> , <i>Duboisia myoporoides</i>	Hyoscine Syoscyamina Atropine	Parasympatholytic
11 <i>Artemisai annua</i>	Artemisinin	Antimalarial
12 <i>Mappia foetida</i>	Camptothecine	Anticancer

### Medicinal Plants used as Crude Extracts / Tinctures in Medicines

Botanical Name	Common Name
1 Belladonna	<i>Atropa belladonna</i>
2 Ipecac	<i>Cephaelis ipecacuanha</i>
3 Opium	<i>Papaver somniferum</i>
4 Henbane	<i>Hyoscyamus niger</i>
5 Stramonium	<i>Datura stramonium</i>
6 Liquorice	<i>Glycyrrhiza glabra</i>
7 Rhubarb	<i>Rheum officinale</i>
8 Podophyllum	<i>Podophyllum emodi</i>
9 Capsicum oleoresin	<i>Capsicum annum</i>

10 Digitalis	<i>Digitalis lanata, Digitalis purpurea</i>
11 Aloe	<i>Aloe vera</i>

#### Important Plant Products having great potential in Medicine

Plant Product	Source	Pharmacological activity
1 Valepotriates	<i>Valeriana wallichii</i>	Sedative, tranquilizer
2 Silymarin	<i>Silybum marianum</i>	Antihepatotoxic
3 Podophyllotoxin (Etoposide/tenoposide)	<i>Podophyllum emodi, P. pellatum</i>	Anticancer
4 Taxol	<i>Taxus baccata</i>	Anticancer
5 Guggul saponins	<i>Cormmiphora wiightii</i>	Hypolipidaemic
6 Artemisinin	<i>Artemisai annua</i>	Antimalarial

#### Some important medicinal plants suggested for cultivation

Botanical name of the plant	Common
<i>Aegle marmalos</i>	Bilva (Hindi); Maredu (Telugu)
<i>Glycyrrhiza glabra</i>	Mulethi (Hindi); Athimadhuramu (Telugu)
<i>Gmelina arborea</i>	Gambhiri (Hindi); Gummadi (Telugu)
<i>Mesua ferrea</i>	Nagkesara (Hindi); Keearamu (Telugu)
<i>Piper longum</i>	Pipli (Hindi); Pippali (Telugu)
<i>Picrorhiza kurroa</i>	Kutki (Hindi); Katukarogani (Telugu)
<i>Phyllanthus niruri</i>	Jar-amlam (Hindi); Nelausiri (Telugu)
<i>Saraca indica</i>	Ashoka (Hindi); Asokachettu (Telugu)
<i>Swertia chirayata</i>	Chirayata (Hindi); Nilavemyu (Telugu)
<i>Andrographis paniculata</i>	Kalmegha (Hindi); Nelavemu (Telugu)
<i>Terminalia arjuna</i>	Arjuna (Hindi); Tellamaddi (Telugu)
<i>Valeriana wallichii</i>	Tagar (Hindi)
<i>Tinospora cordifolia</i>	Gulanchara (Hindi); Thippatheega (Telugu)
<i>Asparagus racemosus</i>	Shatavar (Hindi); Pillitheegalu (Telugu)

<i>Plumbago zeylanica</i>	Chita (Hindi); Chitramulamu (Telugu)
<i>Conuniphora wightii</i>	Guggul (Hindi, Telugu)
<i>Boerhaavia diffusa</i>	Punarnava, Sant (Hindi, Telugu)
<i>Withania somnifera</i>	Ashwagandha (Hindi, Telugu)
<i>Bacopa monnieri</i>	Brahmi (Hindi, Telugu)



## Systems of Medicine

- There are mainly 3 systems of medicine practised in the world today. They are :

### Modern System or Allopathy

- This system was developed in the Western countries. In this system drugs (tablets, capsules, injections, tonics etc.) are manufactured using synthetic chemicals and / or chemicals derived from natural products like plants, animals, minerals etc. This system also uses modern equipment for diagnosis, analysis, surgery etc.
- Medicines or drugs of this system is often criticised for its treatment of the symptoms rather than the cause of the disease, harmful side effects of certain drugs and for being out of reach of common / poor people due to the high cost of drugs and treatment.
- This system is used in all the countries of the world today.

### Alternative Medicine or Traditional System

- Different countries of the world developed independently their own traditional systems of medicine using locally available materials like minerals and products of plants and animals.
- The World Health Organisation is giving considerable importance to these alternate medicine (as they act as alternative to allopathy) systems to provide Primary Health Care to millions of people in the developing countries.
- China developed the Chinese system of medicine, which is practised in China, Singapore, Taiwan, Japan and other countries.
- In Indonesia, Jamu and in South Africa, Zulu systems of herbal medicine are practised. The Unani or Tibb system was developed in the Middle Eastern Arab countries and is practised in India and in many countries.
- In India, Ayurveda (developed in North India), Siddha (developed in Tamil Nadu) and Nagarjuna (developed in

Andhra Pradesh) systems of medicine were developed.

Ayurveda is practised in Sri Lanka, Pakistan and Bangladesh also. Herbo-mineral is another traditional system used in India and other neighbouring countries.

- Drugs (balms, oils, pills, tonics, paste etc) are manufactured and marketed in these systems. The major advantage of these systems is that they are within the reach of the people, particularly rural poor.
- These systems are claimed to be pollution free, eco-friendly and have minimal or no harmful side effects. Ayurveda claims to cure the cause of the disease rather than the symptoms and is holistic in its approach.
- In this system a disease is conceived as an imbalance in the systems of the body and the treatment aims at restoring the balance in the various systems of the body.

#### Folk Medicine

- The medicinal systems followed by various tribals / aborigines of different countries is popularly known as folk or tribal medicine.
- In the system, the "medicine man" or the "doctor" of the tribe who has the knowledge of treating diseases, keeps this knowledge as a closely guarded secret and passes it to the next generation by word of mouth.
- No written texts on these systems are available and different tribes follow different time tested methods. The treatment is often associated with lengthy and mystic rituals, in addition to prescription of drugs (decoctions, pastes, powders, oils, ashed materials etc.).
- Mostly locally available natural materials are used for the preparation of drugs, which are not commercially made and marketed. Generally speaking, folk medicine can also be regarded as a traditional system of medicine.
- The basic aim of all the above systems of medicine is to alleviate the sufferings of human beings and their domesticated animals.
- The knowledge of the traditional systems is undergoing close scientific scrutiny and is being increasingly incorporated into the modern system.

#### Other Systems

- Yoga, Acupressure, Acupuncture, Reiki, Magneto therapy, Pyramid therapy, Flower therapy, Homeopathy, Nature Cure or Naturopathy etc. are some of the other systems of medicine

practised in different parts of the world today.



### Utilization of Medicinal Plants

- The utility of medicinal plants has four major segments:
  - Medicinal plants utilised in indigenous or traditional systems of medicines (ISM) - Ayurveda, Siddha, Unani and Homeopathy systems of medicines.
  - OTC (over the counter, non-prescription) items / products involving plant parts, extracts galenicals etc.
  - Essential oils
  - Phyto-pharmaceuticals or plants used in modern systems of medicine.

### Medicinal plants used in Traditional Systems of Medicine

- Traditional medicine is widespread through the world and it comprises of those practices based on beliefs that were in existence, often for hundreds of years, before the development and spread of modern scientific medicines and which are still in use today.
- As its name implies, it is the part of tradition of each country which employs practices that have been handed down from generation to generation. Its acceptance by a population is largely conditioned by cultural factors and much of traditional medicine, therefore, may not be easily transferable from one culture to another.
- An important feature of traditional therapy is the preference of practitioner for compound prescriptions over single substance/drug as it is being held that some constituents are effective only in the presence of others.
- This renders assessment of efficacy and eventually identification of active principles as required in international standards much difficult than for simple preparation.
- In India, earlier the medicines used in indigenous systems of medicines were generally prepared by the practicing physicians by themselves, but now this practice has been largely replaced by the establishment of organised indigenous drug industries.
- It is estimated that at present there are more than 1,00,000 licensed registered practitioners of Ayurveda, Siddha, Unani medicine or Homeopathy.
- As far as the Ayurveda system of medicine is concerned, it does not rule out any substances being used as potential source of medicine.

- Presently about 1000 single drugs and 8000 compound drug formulations of recognised merit are in vogue.
- In fact reliable data on availability in different regions of country as well as supply and demand of medicinal plants used in production of indigenous medicines are not available.
- However, annual herbal drug market has been estimated around 2200 crores and is expected to reach up to 4000 crores by the year 2000.

#### Plants-parts, extracts and galenicals

- The direct utilisation of plant material is not only a feature of ISM in the developing world but also in developed countries like USA, UK, Germany etc., the various herbal formulations are sold on health food shops.
- Preparation of decoctions, tinctures, galenicals and total extracts of plants also form a part of many pharmacopoeias of the world.
- The current trend of medicinal plants based drug industry is to procedure standard extracts of plants as raw material.

#### Essential Oils from plants

- The essential oil industry was traditionally a cottage industry in India. Since 1947, a number of industrial companies have been established for large scale production of essential oils, oleoresins and perfumes.
- The essential oil from plants includes Ajowan oil, Eucalyptus oil, Geranium oil, Lavender oil, Palmarosa oil, Patchouli oil, Rose oil, Sandalwood oil, Turpentine oil and Vetiver oil.

#### Phyto-pharmaceuticals

- During the past decades, bulk production of plant based drugs has become an important segment of Indian pharmaceutical industry.
- Some of the phyto-pharmaceuticals which are produced in India at present include
  1. morphine,
  2. codeine,
  3. papaverine (*Papaver somniferum*),
  4. quinine,
  5. quinidine,
  6. cinchonine and cinchonidine (*Cinchona sp.*, *C. calisaya*, *C. ledgeriana*, *C. officinalis* and *C. succirubra*);

7. hyoscine,
  8. hyoscyamine (*Hyocyamus niger* and *H. muticus*),
  9. colchicine (*Gloriosa superbad*, *Colchicum luteum* and *Iphigenia stellata*),
  10. cephaeline and emetin (*Cephalis ipacacuanha*),
  11. sennosides A & B (*Cassia angustifolia* and *C. acutifolia*),
  12. reserpine,
  13. rescinnamine,
  14. ajmalicine and ajmaline (*Rauwolfia serpentina*);
  15. vinblastine and vincristine,
  16. ajmalicine (raubacine) (*Catharanthus roseus*);
  17. guggul lipid (*Commiphora wightii*);
  18. taxol (*Taxus baccata*);
  19. artemisinin (*Artemisai annua*) etc.
- For all these segments of drug, perfumery, flavouring and cosmetic industries, mostly the higher plants are one of the raw materials and comes from the natural resources i.e. forests through forest contractors employing local or tribal people or from the drug farms maintained by the growers of aromatic and medicinal plants.

Aloe vera

#### INTRODUCTION :

- *Aloe vera* belongs to the family Liliaceae and is mainly cultivated for its thick fleshy leaves from which the yellow resinous latex or yellow sap or anthraquinones (the bitter yellow liquid between the leaf rind and gel) exudes and can be used as a laxative or purgative. If it is not processed properly it turned out to be poisonous. Nearly there are about 150 species in Aloe vera and these species belong to the succulent family like any other lilies or onions. In India Aloe Vera has been referred to as "kumari" in Ayurvedic treatments where it was popularly used to treat the sore eyes, abrasions and wounds.

#### ORIGIN :

- African Continent

#### SPREAD :

- Aloe is grown largely in South Texas, USA, Mexico, India, South America, Central America, Australia and Africa.

#### FAMILY :

- Liliaceae

#### COMMONLY CALLED AS :

- Miracle plant, Healing plant, Plant of immortality, Fountain of youth.

#### COMMON VARIETIES :

1. *Aloe Barbadensis Miller*,
2. *Aloe Saponaria*,
3. *Aloe Chinensis*,
4. *Aloe Variegata*,
5. *Aloe Forex*,
6. *Aloe Lalifolia and*
7. *Curacao Aloe*.

- Of these the most popular is *Aloe Barbadensis Miller* which has most therapeutic value and referred to as '**True Aloe**'. After all the research, it has been accepted that *Aloe Barbadensis Miller* is the best, as it is the most consistent of all varieties.

#### CLIMATE :

- Aloe is grown in warm tropical areas and cannot survive freezing temperatures.

#### Cultivation Process

##### Soil

- *Aloe Vera* can be cultivated on any soil for 'dry land management', sandy loamy soil is the best suited for it.

##### Propagation

- *Aloe Vera* is generally propagated by root suckers by carefully digging out without damaging the parent plant and planting it in the main field. It can also be propagated through rhizome cuttings by digging out the rhizomes after the harvest of the crop and making them into 5-6 cm length cuttings with a minimum of 2-3 nodes on them. Then they are rooted in specially prepared sand beds or containers.
- The plant is ready for transplanting after the appearance of the first sprouts. The process of cultivating *Aloe Vera* involves the following process:
- The ground is to be carefully prepared to keep free from weeds and the soil is ideally kept ideally slightly acidic. The soil should be supplied supplement in the form of ammonium nitrate every year.

- The plants are set spaced out by 31 inches in rows and between the rows. At that rate, about 5,000 plants are set per acre. An 8 - 12 inch aloe pop would take about 18 - 24 months to fully mature.
- The plants, in a year's time, would bear flowers that are bright yellow in colour. The leaves are 1 to 2 feet long and are cut without causing damage to the plant, so that it lasts for several years.
- The crop can be harvested 4 times a year. At the rate of 3 leaves cut from each plant, about 12 leaves are the harvest per plant per year. On an average, the yield per acre annually is about 60,000 kg.
- The leaves cut off close to the plant are placed immediately, with the cut end downwards, in a V-shaped wooden trough of about 4 feet long and 12 to 18 inches deep.
- The wooden trough is set on a sharp incline so that the juice, which trickles from the leaves very rapidly, flows down its sides, and finally escapes by a hole at its lower end into a vessel placed beneath.
- It takes about a quarter of an hour to cut leaves enough to fill a trough. The troughs are so distributed as to be easily accessible to the cutters.
- The leaves are neither infused nor boiled, nor is any use afterwards made of them except for manure. When the vessels receiving the juice become filled, the latter is removed to a cask or reserved for evaporation. This may be done at once, or it may be delayed for weeks or even months.
- The evaporation is generally conducted in a copper vessel; at the bottom of this is a large ladle, into which the impurities sink, and are from time to time removed as the boiling goes on.
- As soon as the inspissation has reached the proper point, which is determined solely by the experienced eye of the workman, the thickened juice is poured into large gourds or into boxes, and allowed to harden.

#### LEAVES :

1. Its thick leaves contain the water supply for the plant to survive long periods of drought.
2. These leaves have a high capacity of retaining the water.
3. When a leaf is cut, an orange yellow sap drips from the open end which has a very strong laxative effect. When the green skin of a leaf is removed a clear mucilaginous substance appears that contains fibers, water and the ingredients to retain the water in the leaf. These ingredients give this "gel" its special qualities as they are known now for many centuries. Among the uses for this gel are acceleration of wound healing, use on skin burns, moisturizing dry skin and it is taken internally for peptic ulcers or gastritis.

#### USES :

1. Aloe vera helps heal wounds,
2. Aloe vera gel soothes burns,
3. Aloe vera minimizes frostbite damage,

4. Aloe vera screens out radiation,
5. Aloe vera protects from lung cancer,
6. Aloe vera eases intestinal problems,
7. Aloe vera reduces blood sugar in diabetes

#### CERTIFICATION :

- International Aloe Science Council (IASC) is the certifying body of the Aloe industry.

#### DEMAND :

- *Aloe Vera* is among the few medicinal plants by virtue of their extensive medicinal, nutraceutical and other uses enjoy a major chunk of the market across the globe. The major markets for *Aloe Vera* and its extracts are Australia, US and the entire Europe. Despite the ideal climatic conditions for the cultivation of *Aloe Vera*, we have not been able to exploit the excellent potential of the miraculous medicinal plant. The reasons are simple : lack of cultivation and processing know-how.
- Given the exponentially growing demand for it in the international market, *Aloe Vera* presents the finest commercial opportunity among the various medicinal plants. Also, India is among the few countries gifted with the unique geographical features essential for cultivation of *Aloe Vera* and other high potential medicinal plants. Yet, the country has not realized and reaped the full potential of such plants. The reason is simple: lack of the requisite expertise. Fortunately, the technology is now accessible to individual and corporate entrepreneurs to make the most of Aloe through mainstream cultivation.

#### SAFETY :

1. Over dose of Aloe can cause diarrhea and kidney damage.
2. People who are on steroids, pills for irregular heart beat, diuretics, digoxin should not use Aloe.
3. People with intestinal disorders, pregnant and nursing mothers and children below 12 years should not use Aloe / Aloe latex.

Winter cherry(Ashwa Gandha) : *Withania somnifera*

#### Introduction



- Ashwagandha, is an erect, evergreen, tomentose, annual, drought resistant, medicinal shrub growing to a height of 30 - 150 cm.
- The roots, leaves, fruits and seeds contain a number of alkaloids and are widely used in Ayurveda, Unani, Siddha and Allopathy systems of medicine to cure a number of disease.
- The plant grows wild in many parts of India and is cultivated mainly for its roots in parts of Madhya Pradesh. The therapeutic value of cultivated plants is reported to be better than the wild plants.
- The plant can be grown as an irrigated crop in Andhra Pradesh in a wide variety of soils including poor and marginal soils having a PH of 7.5 to 8.0.

#### Varieties

- Jawahar - 20 is a widely cultivated variety.

#### Nursery

- The crop is propagated through seeds. Rainfed crop is directly sown (12 kg seeds / hectare) while irrigated crop is transplanted (5 kg seeds / hectare). The seeds are sown in the nursery beds in 8 - 10 cm rows in the month of June and are regularly irrigated.
- The seedlings are ready for transplanting in about 6 weeks.

#### Cultivation

- The field is ploughed twice, harrowed and planked. 5 - 10 tonnes of farm yard manure, 250 kg of single superphosphate, 50 kg of muriate of potash and 25 - 50 kg of zinc sulphate per hectare are applied basally.
- Sowing / planting is done during rainy season. Rainfed crop is directly sown in rows 60 cm apart and the crop is thinned 4 weeks after sowing to give 60 cm spacing between plants.
- Irrigated crop is interplanted with 8 week old seedlings with a spacing of 60 cm between rows and 60 cm between plants and is immediately irrigated, Until establishment, the field is irrigated frequently, thereafter, at 15 - 20 day intervals. The crop can withstand dry periods.

#### Interculture - Fertilizers

- First weeding is done within 4 weeks of sowing / transplanting thereafter 2 - 3 weeding / hoeings are done to keep the field weed free.
- The crop is fertilized with 85 - 130 kg urea per hectare, 50 % of which is applied at the time of sowing / transplanting and rest in two equal splits 4 - 6 weeks and 12 weeks after planting.
- Spraying of micronutrients and growth regulators is advocated for good yield.

#### Pests and Diseases

- There are no major pests or diseases on the crop. Seed treatment with Captan (3 g/kg of seed) and spraying the 30 days old crop with Dithiocarbamate (0.03%) is suggested to prevent seed rotting, seedling blight and leaf blight diseases.

#### Harvesting - Profits

- The crop is harvested when the leaves and berries start drying up (6 - 8 months after sowing / planting).
- Harvesting is generally done in the months of January to March. The entire plant is pulled out and the roots are separated by cutting the stem 1 - 2 cm above the crown.
- The roots are then cleaned of adhering soil, cut into pieces of 7- 10 cm, dried in sun and stored. The dried berries are collected and threshed for seeds for the next crop.
- The crop gives average yield of 700 - 1000 kg of dried roots and a net profit of Rs. 20000 - 30000 per hectare. Higher yields and profits are possible under good management, ideal climatic conditions and a better price for the roots.
- There is no organised market in Andhra Pradesh, therefore, farmers are advised to make market arrangements before starting cultivation.

#### Blond psyllium (Isabgol)

##### Botanical Name

*Plantago ovata* Forst.

##### Family

Plantaginaceae

##### Important and Utility

- Isabgol (*Plantago ovata*) is an important medicinal crop of India.
- It is a stemless herb. The husk is the rosey-white membranous covering of the seed which constitutes the drug, and is given as a safe laxative, particularly beneficial in habitual constipation, chronic diarrhoea and dysentery.

- India is the largest producer of isabgol and exports seeds and husk worth more than Rs 25 million annually. From the total production of husk in Gujarat, 75% is being exported.

#### Origin and History

- Isabgol is a native of Persia, now grows as a cash crop in the Mehsana, Palampur and Banaskantha districts of north Gujarat. It is also grown in Rajasthan, Haryana and Bihar states.

#### Classification

- Isabgol is an annual plant. Plantago genus comprises 50 species, out of which 10 species are grown in India. Amongst them, 3 are important. They are *Plantago ovata*, *P. indica* and *P. psyllium*.

#### Botanical Description

- Isabgol plant grows upto 30-45 cm height. It is almost stemless with hairs. Its roots are adventitious.
- Main root goes straight down in the soil and produces small roots which spread in the soil.
- Isabgol does not have original stem, which is known as pseudostem. It is hairy and does not have nodes.
- Actually it is petiole of inflorescence. Every plant produces 25-100 pseudostems after 60-70 days of sowing. Leaves possess parallel vein-structure. Leaves arise in large number from the base of plant.
- Inflorescence of isabgol is long and its length may be 1.5 - 4.0 cm, which is known as awn or bristle. In isabgol, the female flower matures early than the male flower, hence mainly cross pollination takes place.
- Flowers are petioleless, non-leafy small, bisexual, incomplete and irregular.
- Fruit is a capsule which is ellipsoid in shape. Its length is 8 mm. Every fruit contains 2 seeds. Fruit inflorescence start ripening from the end. Seed length is 3mm, boat shaped, glossy and white.

#### Climate

- It requires a cool climate and dry sunny weather during maturation, even a mild dew, cloudy weather or light or light showers cause seed shadding.
- Temperature 20-25°C is required for seed germination, whereas at time, maturing it requires 30-35°C temperature. It requires 50-125 cm annual rainfall.

#### Soil

- The crop grown in marginal light, well-drained sandy-loam to loamy soils having pH between 7 and 8.

- To get more yield the soil should have NPK in enough amount.

#### Crop Rotations

- The following crop rotations are being adopted in various parts of India.
  1. Soybean - Isabgol
  2. Maize - Isabgol
  3. Sorghum - Isabgol
  4. Onion - Isabgol
  5. Groundnut - Isabgol
  6. Maize - Isabgol - Greengram

#### Field Operation

- After harvesting the kharif crops, such as sorghum (*Sorghum bicolor*), the land is brought to fine tilth and laid out into beds of convenient size for irrigation.

#### Manure and Fertilizers

- Isabgol makes a moderate demand for nutrients, usually 25 kg each of N and P/ha is given at planting and another 25 kg of N is applied with the third irrigation.
- Apart from these fertilizers, it is advisable to apply 8-10 tonnes FYM or compost.

#### Seed and Sowing

- The seed rate is 7-8 kg/ha. Seeds are small and light about 600 mg-/g and are sown by broadcast. They are covered thinly by raking the soil. A light irrigation is given immediately.

#### Irrigation

- Isabgol requires more irrigation. As already stated about that a light irrigation should be given just after sowing and the crop is given the second irrigation after 3 weeks and a third one at the time of formation of spikes; thus the crop needs 6-7 irrigations, It is advisable that no irrigation should be given at flowering stage.

#### Hoeing and Weeding

- The crop is given 1 or 2 hand weedings during the entire growing period.

#### Harvesting

- The plant bears the flowering spikes in about 60 days after sowing and matures in the next 2 months.

- The yellowing of the lower leaves is an indication of maturity, that can be confirmed by pressing a spike between 2 fingers when the mature seeds come out. The crop is harvested to close to the ground in the early morning hours to avoid losses owing to seed shadding.
- The harvested material is stacked for 1 or 2 days, made to be trampled by bullocks, winnowed and separated seed is collected.

#### Processing

- The seeds are processed through a series of grinding mills to separate the husk and about 30 % of husk by weight is thus recovered. The husk contains a mucilaginous substance.

#### Yield

- The average yield is 10 quintal/ha. A bold seeded crop fetches a better price.

#### Medicinal (Steroidal) Yams (*Dioscorea floribunda*, *Dioscorea deltoidea*, *Dioscorea composita*)

#### Introduction



- Medicinal yams are robust, perennial, branched, climbers native to tropical Asia, Africa and South America. The underground rhizomes / tubers contain alkaloids like diosgenin, pannogenin and are used for the synthesis of antiarthritic, anti-inflammatory, antifertility, anabolic drugs.
- The demand in India is estimated at 60 - 100 tonnes per annum. Tubers are collected from the wild growing plants in Jammu and Kashmir and Uttar Pradesh States and from cultivated plants in Karnataka and Tripura States.
- The crop can be grown as an irrigated crop in Andhra Pradesh in light and medium textured, deep soil rich in organic matter.

#### Varieties

- FB(C)t, Arka, Upkar are the improved varieties of steroidal yams.

#### Nursery

- Steroidal yams can be propagated through tubers / rhizomes, stem cuttings or seeds. Commercial plantations are raised through tuber pieces.
- Tubers give three kinds of pieces namely crown (low alkaloid content), medium and tips (high in alkaloids). Crown (Stem ends) are used for planting as they sprout early.
- 50 - 60 g pieces of crowns are planted in raised nursery beds in shade covered with stand and regularly watered. After 30 days the crowns sprout and are ready for planting.
- About 2.5 tonnes of crown are required for planting one hectare.

#### Cultivation

- The land is brought to fine tilth by ploughing twice, harrowing and planking. 15 - 20 tonnes of farm yard manure, 950 kg of single superphosphate, 250 kg of muriate of potash and 25 - 50 kg of zinc sulphate per hectare are applied basally.
- Planting is done in February - March with a spacing of 60 - 90 cm between rows and 30 - 45 cm between plants and the field is immediately irrigated. The field is irrigated frequently till the crop establishes, thereafter at 10 - 15 days intervals during non-rainy periods.
- The crop needs support for optimum growth. 1.95 meters high stone pillars spaced at 9 meters apart and connected with G.I wires of 12 gauge are used for erecting trellis. The vines are trained on to this support.

#### Interculture - Fertilizers

- The field is periodically weeded. Intercropping with legumes like Cowpea, Horsegram, French bean etc., gives bonus yields and extra income without affecting the yield of medicinal yams.
- The crop is fertilized with 450 - 650 kg urea per hectare in 3 equal splits. Spraying of micronutrients and growth regulators is advocated for good results.

#### Pests and Diseases

- Aphids and Red spider mites cause damage to the crop occasionally. Spraying of Rogor (2 ml/litre of water) or Kelthane (3 g/litre of water) controls these insects.

#### Harvesting - Profits

- Two to three years old crop is harvested in February - March. The tuber / rhizomes are dug out, cleaned of adhering soil and dried. The crop on an average gives 5 - 7 tonnes (2 year) or 6 - 8 tonnes (3 year) of dried tubers and more than Rs. 25,000 net profit per hectare.

There is no organised market in Andhra Pradesh. Therefore, farmers are advised to make market arrangements before starting cultivation.

## Indian Long Pepper (*Piper longum*, *P. peepuloides*)

### Introduction

- Indian long pepper is a slender, perennial, aromatic, and medicinal climber with woody roots growing to height of 90 - 120 cm.
- The fruits and roots contain essential oil and alkaloids like piperine, pipartine and are used for cough, bronchitis, asthma, muscular pains, inflammation, coma, drowsiness, insomnia, epilepsy, disease of bile duct, dysentery, stomach disorders, leprosy and tuberculosis.
- Fruits are collected from wild growing plants in Assam, West Bengal, Nepal, Uttar Pradesh and Kerala States. It is cultivated in parts of Assam, Tamil Nadu and Andhra Pradesh (Paderu tribal agency area of Visakhapatnam district).
- In Andhra Pradesh, it can be grown as an irrigated crop in well drained, medium to heavy textured soils rich in organic matter.

### Varieties

- There are no released varieties in this crop.

### Cultivation

- Indian long pepper is propagated through stem cuttings or suckers.
- The field is prepared to good tilth by ploughing twice, harrowing and planking. 10 - 15 tonnes of farm yard manure, 250 kg of single superphosphate, 65 kg of muriate of potash and 25 - 50 kg of zinc sulphate per hectare are applied basally.
- Planting is done during rainy season. Stem cuttings 30 cm long having at least 3 nodes are planted in 15 cm deep holes leaving 1 node above the ground at a distance of 60 - 90 cm between the rows and 15 cm between the plants (74,000 - 1,11,000 cuttings / hectare). The crop is irrigated at 15 - 20 days intervals during non - rainy periods.

### Interculture - Fertilizers

- The field is weeded periodically and kept weed free.
- In Visakhapatnam are the tribals intercrop turmeric in Indian long pepper without any adverse effects on the crop.
- Generally the crop is fertilized with manures only. Application of 150 kg urea in 3 equal splits is suggested for

- good yields.
- Spraying of micronutrients and growth regulators is also advocated for good results.

#### Plant protection

- There are no pests or diseases on this crop which cause severe damage, hence plant protection practices are not needed.

#### Harvesting - Profits

- When the crop is raised for fruits, it comes to bearing from third or fourth year after planting.
- The fruit yield per hectare increases from 500 - 700 kg in the first year of bearing to 1600 - 2000 kg in the second and third years of bearing after which yields decline, therefore, the crop is to be replanted.
- The spikes are harvested while still green and unripe, as they are most pungent at this stage.
- When the crop is grown for roots, it can be harvested after 18 months, however, in practice 3 - 7 year old roots are harvested as they are said to be of good quality. The roots are dug out, cleaned, cut into pieces of 2.5 - 5.0 cm, dried in shade and stored.
- The roots are graded into three grades such as Grade - I (thick root and underground stem), Grade - II and Grade - III (thin roots, stem and broken fragments). Grade - I roots fetch higher price than other grades.
- A three year old turmeric intercropped Indian long pepper gives 700 - 1000 kg roots and a net profit of more than Rs. 42,000 - 60,000 per hectare.
- There is no organised market in Andhra Pradesh, therefore, farmers are advised to make market arrangements before starting cultivation.



#### Centella - Indian pennynut

- Hindi: Brahmanduki, Brahmi  
Bengali : Thankuria  
Gujarati: BArmi  
Kannada: Vondelega  
Marathi : Brahmi  
Punjabi: Brahmibuti  
Sanskrit : Mandukparni

Tamil: Vallarai elai  
Telugu : Bokkudu, Nacley  
Malayama: Muthil, Kudangal  
Assamese:Aghinya

- The sanskrit name 'mandukparni' refers to the leaves of the plant, which resembles the claw of a frog.
- In some regions of North India, this plant is treated as 'Brahmi'.
- Actually 'Brahmi' is another plant having the scientific name *Bacopa monnieri*.
- According to some Ayurvedic literature they resemble each other in their medicinal properties, but botanically they are entirely different.

#### Distribution

- It is a native of Madagascar, but is widely distributed throughout the tropics of both hemispheres.
- It is found in moistured areas throughout India.
- It can be commonly found in marshy banks of streams, ponds, rivers and irrigated lawns, where there is moistured soil up to 1500 Mt Elevation.

#### Description



- This herb has slender stem, which grows horizontally along the soil.
- Nodes produce slightly erect leaves to the top and roots to the down.
- Leaves are simple, kidney shaped or rounded with slightly serrate margin and having a diameter between 2-10 cm.
- Flowers are small, brown or red in colour..
- Single bunch contains 3-6 flowers.
- Fruits are small look like barley grains.

#### Medicinal Importance

- The plant contains asiaticoside, which is responsible for its use in leprosy.
- The plant is also found useful in certain kinds of tuberculosis.
- Centella plays a major role in the treatment of mentally retarded patients for improving their mental ability.
- It is also very useful in the case of anxiety neurosis.
- Experiments on animals have confirmed its property of inducing fast growth of skin, hair and nails.

- Leaves of this plant are widely used against various skin diseases, cuts and wounds.
- Its capacity to improve mental stability, memory power and concentration is experimentally proved.

#### Parts used

- The drug comprises fresh and dried leaves, stems, roots and seeds.

#### Some medicinal usages

- Usage of dried plant powder (0.5 gm) continuously for 12 weeks may improve memory power, concentration and mental stability in mentally retarded patients.
- Seven days usage of leaf juice (20 ml.) with milk cure Leucorrhoea
- Usage of leaf juice early in the morning (10 ml.) will improve body colour and body strength.
- Leaf juice with honey is an effective remedy for urinary problems.
- Leaves are also used against skin diseases, wounds etc.,
- The leaves or entire plant parts are boiled in water and this decoction is used in the treatment of leprosy.

#### Other uses

- Beautiful lawns can be prepared by cultivating this plant in the garden

#### Chemical nature

- The powder of entire dried plant contains amino acids, aspartic acid, glycine, glutamic acid and phenylalanine.
- The burned ash of the plant contains chloride, sulphate, phosphate, iron, calcium, magnesium and sodium.

#### Cultivation technique

- Nodes, which produce roots can be used as a source for cultivating this plant.
- This can be cultivated in polythene bags containing biofertilizers or directly to soil itself.
- It is moist loving so frequent watering and shading is very important.
- It can be cultivated easily, no extreme care is essential.

#### Liquorice (Sweet root) : *Glycyrrhiza glabra*

##### Introduction

- Liquorice is a hardy perennial drought tolerant medicinal herb growing to a height of 60 cm.

- Its dried, peeled or unpeeled underground stems and roots contain glycyrrhizin, glabrin, glycyrrhizic acid and are used for soar throat, cough, myopia, stomach ulcers, stomach disorders, muscular pains, mouth disorders, baldness, irritation in urinary tract, corn etc.
- Large quantities of roots are also used in confectionery and tobacco blending. It is a West Asian plant and large quantities of root are imported by India.
- The crop can be grown as a partially irrigated crop in Andhra Pradesh in light textured and saline soils.

#### Varieties

- EC 111236, EC 124587, EC 21950, Mishree is a high yielding variety released by CIMAP.

#### Cultivation

- The crop is propagated through rooted cuttings, runners or underground stem pieces (10 cm length).
- The land is brought to fine tilth by ploughing twice, harrowing and planking. 15 - 20 tonnes of farm yard manure, 250 kg of single superphosphate, 65 kg of muriate of potash and 25 - 50 kg zinc sulphate per hectare are applied basally.
- Planting is done at the end of the winter or in the spring season (February to March) at a spacing of 90 cm between rows and 45 - 60 cm between plants. Dry condition at the time of planting and in the next few months gives best chance for a good crop.
- Field is irrigated at weekly intervals during summer months.

#### Interculture - Fertilizers

- First weeding is done within 4 weeks of planting thereafter the field is kept weed free by frequent weedings.
- The crop is fertilized with 85 - 130 kg urea per hectare in three equal splits at the time of planting, 6 and 12 months after planting.
- Spraying of micronutrients and growth regulators is advocated for good yield.

#### Pests and Diseases

- Termites, leaf spot and root rot, cause damage to the crop. Apply Aldrin or Chlordane 5 % dust @ 25 - 30 kg per hectare to control termites.
- For leaf spot, spray the crop with Carbendazim 0.04 % and to control root rot avoid waterlogging and spray the crop with Brassicol @ 5 kg per hectare.

#### Harvesting - Profits

- The flowering shoots are removed whenever they appear, otherwise inferior quality rhizomes / roots are produced. The crop is harvested 15 - 24 months after planting, generally at the end of the rainy season.
- The rhizomes / roots are dug out, cleaned of adhering soil, cut into 15 - 20 cm, long pieces and dried alternatively in sun and shade or mechanically using driers at 30 - 40°C.
- The crop gives an average yield of 2 - 3 tonnes of dried roots and a net profit of more than Rs. 25000 per hectare.
- There is no organised market in Andhra Pradesh for liquorice roots, hence farmers are advised to make market arrangements before starting cultivation.

#### Medicinal Plants

Opium poppy : *Papaver somniferum*

#### Importance and Utility

- Opium poppy (*Papaver somniferum*) is an important crop of India, because it produces capsule.
- That contains milk, from which opium is prepared.
- Opium possesses various types of alkaloids which are used for preparing medicines for the use of human and cattle.
- There are 25 types of alkaloids identified in raw opium; of them, morphine, codeine, narcotine, narcein, thebaine, papaverin and hydrochloride are important. Morphine is by far the most important.
- Since they are having very stimulating matter, they are used as narcotic, sedative, anodyne, cough and respiratory diseases.
- It is also used for cancer and head trauma treatments.
- Seeds are used for preparing the bread, shorba, sweets and biscuits.
- Its oil is odourless and taste is just like almond.
- It is used for preparing dishes, ointments and colour and paints.
- Sometimes its oil is given to the patients of diarrhoea and dysentery which gives relief to the patients.
- Its oil is also used on the burnt part of the body.
- Its cake is sweet and nutritive and is consumed by the people.
- Its decoction is also given to the patients of continuous problem of cough.
- The main importers of Indian opium are Britain, USA and France.
- A part from these Italy, Russia, Western Germany, Belgium and Argentina purchase Indian opium in limited quantity for the preparation of medicines.

## Origin and Development

- Opium poppy is a native of western Mediterranean region, introduced into India in the early sixteenth century.
- India produces about 70% of the world's production and 90% of it is exported annually.
- Its cultivation is restricted to about 24,000 ha in the districts of Neemuch, Mandsaur and Ratlam in Madhya Pradesh; in Faizabad, Bara Banki, Bareilly and Shahjahanpur in Uttar Pradesh, and in Chittoor, Jhalawar and Kota in Rajasthan.

## Distribution

- Since ancient times, its cultivation is going on in Italy, Greece and Minor Asia.
- At present, it is being cultivated mainly in India, Russia and Turkey.
- It is also grown in Yugoslavia, Bulgaria, Afghanistan, and Japan in a limited scale.
- Central Europe grows this crop for seed production only, but since 1930, it is being cultivated for production of seedless capsules from which opium is obtained.

## Botanical Description



- Poppy is an annual erect plant, 60-120 cm high, rarely branching, with ovate oblong leaves; it bears large showy flowers and nearly globose to spherical capsules, containing small white or black kidney shaped seeds.
- It is a rabi crop and remains for about 150-160 days in the fields.
- It is mainly self-pollinated, since the dehiscence of anther takes place before the opening of the flower.

## Classification

- Opium poppy belongs to Papaveraceae family and its genus is Papaver.

- This genus possess about 50 species, which are grown to produce opium and seed as well as for the decoration in gardens.
- In India, 6 species are found from which the following are important one.
  1. Papaver nudicaule linn.
  2. Papaver dubium linn.
  3. Papaver rhoeas linn.
  4. Papaver somniferum linn.

#### Climate

- Poppy prefers moderately cool weather and open sunny location; severely cold spell, frost, dull cloudy weather, high winds and very heavy rainfall during the lancing period adversely affect the yield.

#### Soils:

- The crop is grown on well-drained, fertile, clayey loam to rich sandy - loam soils.
- Well - drained loam and sandy-loam soils are best for its cultivation.
- Soil having pH of 7 are best for its cultivation.
- Soil should also have adequate quantities of organic matter and plant nutrients.

#### Field preparation

- Land is prepared to a fine tilth to a depth of 20-25 during september and the fields are laid out into beds of convenient size.
- Twenty five to thirty seven cartloads of farmyard manure are mixed with the soil during the preparation of land, penning of sheep or goats is preferred.
- There should be enough moisture in the soil for seed germination.
- If sufficient moisture is not available, give a presowing irrigation for obtaining good germination.

#### Improved Varieties:

- Poppy (Papaver somniferum)are new varieties, but there are only 2 varieties, 2 which are grown for opium and seed.

#### Subvar Album:

- This variety is mainly in Cyprus, Minor Asia, India and Iran for opium production

#### Subvar nigum:

- This variety is grown in Europe for seed production.
- In India subvariety album is grown for opium production.
- On the basis of colour of flowers it is divided into the following 2 types.
  1. White flower and white seed varieties: This is grown in Uttar Pradesh
  2. Red and violet flower varieties: This is grown in Madhya Pradesh and Rajasthan (in Malwa region).
- In India, several races are grown.
- There is lot of difference in the shape of plant, constitution of leaves, petals, colour, size of capsule and opium production.
- Not only this, there is a difference in the colour quality of opium.
- Major alkaloids are also different in the opium.

#### Varieties grown in Uttar Pradesh

- Telia, Haryali, Safed Dhanti or Kantha Bhabhutiya, Katila, Hariyali, Dhandhan Baha, Chiroh, Kali Dadi or Kali Dandi, chaura Karia, Damia, Mororia, Katila, dhadhua and Sahabnia etc.

#### Varieties grown in Madhya Pradesh and Rajasthan

- Bhadphoria or Dhaturia, Ramjatak, Telia, Galania, Chotia, Chaglia, Kasturi or Tejoni, Kantia and Gebra.

#### Seed and sowing

- The seed rate is 2.5-3.5 kg/ha.
- The seeds are minute weighing 0.25-0.5 g/100.
- They are mixed with sand and sown thinly in rows 30 cm apart during mid-October till early November.
- The rows are covered with a thin layer of soil and are given a light irrigation, followed by another irrigation after 8-10 days when the seeds start germination.
- Seed treatment with 1.0% Agrosan GN protect it from seed

borne diseases.

#### Plant protection methods

- The crop is attacked by the leaf miner (*Phyllocnistis* sp.), which can be kept under control by spraying with 0.2% Metasystox or Rogor.
- Sometimes, cutworms (*Agrotis suffura* Hubn), cause damage to the young plants, the flooding of the fields makes these worms float on the water and they are ultimately picked by birds.

#### Irrigation

- The crop is given about 15 irrigations in all, depending upon the structure of soil and the variety sown, moisture deficiency at the time of capsule formation affects the yield adversely.

#### Hoeing and weeding:

- The crop seedlings are thinned out to 22-25 cm apart when they grow 5-7 cm tall.

#### Manure and fertilisers

- The poppy crop needs a heavy nutrients supply and 50 kg N/ha is applied during the preparation of land and another application of an equal quantity is given as top dressing in two split doses, when the crop is 1 month old and at the time of flag 2 leaf stage.

#### Diseases

- Downy mildew (*Peronospora arborescens* berk de bary) sometimes causes serious damage to the crop at the time of capsule formation.
- It is controlled by the application of 0.2% ditahne Z 78.
- Root rot due to *Rhizoctonia* is also reported on the crop.

#### Harvesting

- Lancing is done longitudinally in bright sunlight and the latex (crude opium) which oozes from the wounds dries during the following night and is scraped with the sharp kitchen-knife in the early hours of the succeeding morning.
- Lancing is performed in the afternoon with a special knife,

capable of making 4 incisions at a time, each at about 1/12th cm apart.

- Each capsule is lanced for 4-6 times.
- A deep incision causes the collection of the latex inside the capsule and spoils the seeds.
- The crude opium is stored in earthen-pots and dried under the sun to obtain the raw opium of a uniform consistency.
- The entire produce goes to the Excise and Narcotics Department which pays attention to its consistency and purity.

#### Yield

- The average yield of raw opium varies from 13 to 33 kg/ha though much higher yields are recorded under good agronomic practices.
- The crop also yields 3-4 quintals of seed/ha.
- The seed contain 50% of a golden yellow fatty oil which is devoid of narcotic properties.

Periwinkle (*Catharanthus roseus* syn, *vinca rosea*)

#### Introduction



- Periwinkle is a perennial tropical herb and is cultivated as an ornamental. This has been catapulted into the international limelight of modern medicine owing to utilization of vincristine series of alkaloids which can be extracted from the leaves of young plants.
- The alkaloids have been used extensively in the pharmaceutical industry for the treatment of various types of cancer and malignant growth. ajmalicine is another type of alkaloid which can be extracted from the roots of same plants and have therapeutic value in controlling hypertension and capillary fragility.
- These alkaloids have found use in the cardiovascular research well. International pharmaceutical companies like M/s Eli Lilly, USA and even M/s CIPLA from India are known to be leading organizations in production and utilization of the alkaloids from periwinkle.
- India is one of the major producers and principal exporters of crude drug. Mozambique, Malaysia and Madagascar are the competitors

### Varieties

- Nirmal and Dhawal are high yielding white flowered varieties which are resistant to common diseases

### Climate and soils

- This can be grown in wide variety of habitats, marginal lands with scarcity of water and nutrients and sandy/loamy soils.
- It can be grown as rainfed crop provided there is even distribution of rain(100 cm) throughout the year.

### Propagation

- This plant is amiable to vegetative propagation by root and stem cuttings and responds very well to the application of growth regulators. Direct sowing of seeds is also recommended

### Cultivation

- The land is prepared to fine tilth by ploughing, harrowing and planking and dressed with FYM @ 10-15 tonnes per hectare .
- seeds are sown during spring and if delayed just before monsoon. In Andhra Pradesh, it can be planted in almost throughout the year.
- About 2.5 kg seeds are required for a line sown crop line to line distance id kept 45-60 cm. If planted through root cuttings, about 3-4 quintals roots per hectare are required

### Interculture-Fertilizatrion

- The crop requires 4-5 irrigations around the year. The land must not be waterlogged. First weeding is done 20-25 days after planting.
- Thereafter, depending upon requirement, crop is weeded 2-3 times Rainfed crop is fertilized with NPK @ 80:40:40: kg per hectare, respectively. The application of nitrogen is done in split doses.
- The crop also responds to micronutrients and particularly zinc sulpahte

### Pest and diseases

- No major pests and diseases have observed. Watterlogging is harmful for the growth of the crop and therefore good drainage is essential .

### Harvesting - profits

- The first harvest of leaves is done at 6 months and subsequent harvests at 3 months intervals.

- Roots are harvested only once after about year or more. Roots harvested are washed under shade and dried by hot air during the rainy season.
- Then the roots are taken to factories for extraction for extraction of alkaloids. The production of root alkaloids of ajmalicine series varies from 0.1-2 percent.
- Rainfed crop yields 1,500-2,000 kg of leaves and 600-700 kg roots and a net profit of more than Rs. 12,000/hactare.
- Likewise irrigated crop yields 3,000-3,500 kg leaves and 800-1000 kg roots and a net profit of more than Rs 25,000 per hectare(considering cost of leaves Rs.10/- per kg and roots Rs.20/- kg)
- Market fluctuations are not uncommon in periwinkle and the farmers are to keep this in mind before taking up cultivation

Senna (*Cassia angustifolia*)

### Introduction



- Senna, is a small, perennial, branched, drought resistant undershrub growing to a height of 60 - 75 cm.
- The leaves and green, immature pods contain glycosides like sennocides A and B, which are extensively used as a laxative particularly for habitual constipation.
- The crop is cultivated in Tirunelvely and Ramnathapuram districts of Tamil Nadu, Guntur district of Andhra Pradesh in India and in Sudan. Leaves and pods are exported from India.
- The crop can be grown as an irrigated crop throughout Andhra Pradesh on marginal red laterites, red soils, coarse gravelly soils, alluvial loams and on rich alayey soils, ranging in PH from 7.0 to 8.5.

### Varieties

- There are two varieties namely, local which is early flowering and ALFT 2 which is late flowering. The yields from these varieties are identical.
- Sona is a high yielding variety released by CIMAP.

### Cultivation

- The crop is propagated through seeds. 15 kg seeds are required per hectare. The land is prepared by ploughing twice, harrowing and levelling. 5 - 10 tonnes of

farm yard manure, 250 kg of single superphosphate, 70 kg of muriate of potash and 25 - 30 kg of zinc sulphate per hectare are applied bassally.

- The seeds are sown in 30 -45 cm rows at the end of rainy season (September). After germination plants are thinned to maintain 30 cm plant to plant distance.
- In Tamil Nadu, the crop is seeded either in February - March (irrigated) or in November (rainfed). The crop is very sensitive to high soil moisture, therefore, only light irrigations are to be given initially at 6 - 7 day and later 15 - 20 day intervals. A total of 5 to 8 irrigations are to be given.

#### Interculture - Fertilizers

- First weeding is done within 6 weeks of sowing, subsequently after each harvest of leaves / pods.
- The crop is fertilized with 90 kg urea per hectare 30 days after sowing and 45 kg urea each time after first and second leaf harvests. Micronutrients and growth regulators may be sprayed for good crop growth.

#### Pests and Diseases

- Leaf spot caused by *Alternaria alternata* and leaf blight caused by *Phyllosticta* spp. cause severe damage to the crop through leaf drop.
- Spraying of Carbandazim (0.03%) or Dithiocarbamate (0.03%) at fortnightly intervals for 3 times is recommended. Damping off of seedlings caused by *Rhizoctonia bataticola* is common in fields affected by stagnating moisture.
- Seed treatment with Thiram or Captan (2.5 g / kg seed) before sowing is advocated.

#### Harvesting - Profits

- The crop flowers 2 months after sowing which are removed to encourage side branching. Fully grown, thick and bluish coloured leaves are stripped manually. Golden yellow coloured immature pods are harvested.
- First leaf harvest is taken 90 days after sowing, subsequent two harvests are obtained at 30 - 40 day intervals. Pods are harvested with second and third leaf harvests.
- The leaves and pods are shade dried for 5 - 10 days, pressed into bales and stored.
- The crop yields 1500 - 2000 kg dried leaves, 150 - 200 kg dried pods and a net profit of Rs. 25000 - 30000 per hectare per year.
- If the crop is raised purely under rainfed conditions, the yields and profits would be approximately 50 % of the irrigated crop. It can also be grown as a perennial crop.
- Developed markets are available in Tamil Nadu and private individuals are encouraging cultivation with buy - back arrangements in Andhra Pradesh. Farmers are advised to take up cultivation after ascertaining the market for the produce.

## Shatavri (*Asparagus racemosus*)

### Introduction



- *Asparagus racemosus* popularly known as Shatavri is an indigenous plant used in Siddha and Homeopathic medicines.
- It belongs to the family Liliaceae and its related species are *A. adscendens*, *A. filicinus* which are found in the temperate regions like Kashmir and Bhutan. The other species, viz., *A. officinalis*, *A. gonocladus* and *A. sarmentosus* are distributed in the Konkan regions of Karnataka and Maharashtra. Shatavri roots are used mainly as a lactagogue which promotes secretion of breast milk.
- It is useful in improving the lost body weight and is also considered as an aphrodisiac.
- The root is useful in curing dysentery, diabetes and tuberculosis. In general it helps to maintain the health by providing immunity to diseases.
- The demand for Shatavri roots is on the increase and the destructive nature of harvesting the entire whole plant has resulted in the shrinking of population. It is estimated that in India, more than 500 tonnes of Shatavri roots are required every year for medicinal preparations.
- But it is doubtful that such a huge quantity could be available under natural conditions.
- The supply is rather erratic and inadequate due to the declining forest area. The species holds a promising scope for cultivation on a commercial scale under selected environment.

### Climate and soil

- The species grows under varied agro-climatic conditions ranging from temperate to tropical hill ranges.
- It is widely distributed in the western and Eastern ghat hills. It can be commercially cultivated in moderate hills like Shevroy, Kolli, and Kalyan hills and medium elevation of western ghat hills where the elevation is between 800-1500 m above MSL.
- Shatavri is a thorny climber which grows to the height of 180 cm. The plants are hardy vines found trailing on bushes along the dry hill slopes.
- It is an ideal crop for raising as an intercrop in coffee plantations. The crop prefers lateritic, red loamy soils with adequate drainage. The plants are hardy and survive adverse conditions like drought and low temperatures.
- Being a shallow-rooted crop, it can be grown in rocky soils where soil depth is hardly 20-30 cm.

## Propagation

- It is propagated by root suckers or seeds. For commercial planting, root suckers are preferred

## Land preparation, fertilization and planting

- The land is prepared well by digging up to 15 cm depth. Application of high level organic manure is generally recommended for this crop.
- About 15-20 tonnes of FYM should be incorporated for one hectare area. Inorganic fertilizers @ 100 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O per hectare is recommended.. ridges are prepared 60 cm apart.
- Well developed root suckers are prepared and planted at 60 cm spacing. About 28,000 plants are required for planting one hectare

## Interculture

- Shatavri, being a climber, requires support for its growth . for this 1.2-1.5 meters long stakes are used to support the growth of vines.
- Besides stacking, it requires 2-3 manual weedings in the initial stages of the growth.

## Harvesting

- The plants flower during February- March leaving a mild frangrance in its surrounding .
- By the end of April , fruits can be seen with attractive red berries. Each plant produces 16-20 elongated fleshy tubers which have sweet and mild flavour. The tubers upon maturity are often consumed by the local tribes as a substitute for food.
- The tubes are economic part and used either as fresh or after drying. The tubes come to maturity within 12-14 months after planting depending upon the soil and climatic conditions

## Yield and economics

- A single plant yields 500-600 g of fresh roots. On a average, 12-14 tonnes of fresh roots can be harvested in one hectare.
- Up on drying, the roots yield is 10-12 q/ha. Well matured and dried Shatavri roots can be marketed @ Rs.40-50 /ka. Therefore a gross income ranges between Rs.40,000-60,000/ha accordingly net profit ranges from Rs 20,000-40,000/ha

## Solanum (Solanum khasianum / Solanum viarum)

## Introduction

- Solanum is a stout, much branched, annual, medicinal undershrub growing to a height of 75 - 150 cm.
- The mature berries contain glycoalkaloid, solasodine, which is widely used for synthesis of anti-inflammatory, anabolic, aritifertility (oral contraceptive) drugs. The plant grows wild in many parts of India and is cultivated in Maharashtra.
- This can be grown as an irrigated crop throughout Andhra Pradesh in a wide variety of well drained soils, except in water logged soils.

#### Varieties

- RRL20-2, RRL-SL-6, Glaxo and Arka Sanjivini are improved varieties of Solanum.

#### Nursery

- The crop is propagated through seeds. 1.0 to 1.5 kg seeds are sown in rows 8 - 10 cm apart in nursery beds in the month of June and are irrigated daily. The plants are ready for transplanting in about 4 weeks after sowing.

#### Cultivation

- The land is prepared by ploughing twice, harrowing and planking. 5 - 10 tonnes of farm yard manure, 250 kg of single superphosphate, 65 kg of muriate of potash and 25 - 50 kg of zinc sulphate per hectare are applied basally.
- The seedlings taken from the nursery are transplanted in the main field during rainy season with a spacing of 50 cm between rows and 50 cm between plants (40,000 plants / hectare and the field is irrigated immediately.
- The crop is irrigated at 15 - 20 day intervals during non - rainy days.

#### Interculture - Fertilizers

- The first weeding is done 4 weeks after planting, thereafter, one or two weeding / hoeings are done to keep the field weed free.
- The crop is fertilized with 175 - 220 kg urea in three splits, 50 % at the time of transplanting and 25 % each 6 and 10 weeks after transplanting. Micronutrients and growth regulators may be sprayed atleast once for good yields.

#### Pests and Diseases

- Damping - off of seedlings, yellow vein mosaic, leaf spot and wilt diseases occur occasionally. Seed treatment with organomercurial compound (0.1%) before sowing, Dimethoate (0.2%) + Zineb (0.2%) spray 3 - 4 weeks after sowing is advised.
- To control aphids, mites, fruit borer and weevil grub, the crop may be sprayed with Phosphamidon, Quinolphos, Carbaryl or Malathion.

- Pests and diseases do not cause heavy damage to the crop under normal conditions.

#### Harvesting - Profits

- The fruits / berries are harvested when their colour changes from green to yellow and before they over-ripe.
- The crop takes about 6 months to be ready for harvesting. The harvested berries are sun-dried for 4 - 5 days and stored.
- Under good management, the crop yields 75 - 100 quintals of dried berries and a net profit of Rs. 25000 - 33000 per hectare per year. Higher profits can be obtained if the solasodine content of the berries is higher.
- Farmers are advised to work out purchase tie-up arrangements with interested firms before starting cultivation.

#### Safed Musli (*Chlorophytum sp.*)

##### Introduction

- It is an indigenous medicinal plant of Central India that naturally grows in large quantities in the forests of Madhya Pradesh, Gujarat, Maharashtra, Uttar Pradesh etc.
- It is a small tuberous plant measuring 30-50cm with a life span of 3-8 months and it surfaces once in a year during the rainy season.
- Its tuber finds wide application in Ayurvedic medicine as a general health tonic. During the last decade, some systematic efforts have been made to popularise the cultivation of Musli which show that its cultivation is much more profitable than many other crops.
- Presently, there are about 100 farmers in the country who have taken up its cultivation in a big way.

##### Varieties

- In commercial parlance, 3 types are known :
  1. *C. borivillianum*
  2. *C. arundinaceum*
  3. *C. Tuberocum*

##### Soil and Climate

- Climatic conditions of the Central region suit the crop most and it grows successfully in a wide range of temperatures and rainfall.
- Sandy loam soils with a proper drainage system facilitate its growth.

## Cultivation

- The land is prepared well in the month of April - May with addition of 10-15 trolleys FYM per acre.
- Green manure as preceding crop can also be used to enrich the soil. Raised beds (1 foot height x 3.5ft width) of suitable length are prepared to facilitate proper drainage and growth of tubers.
- Sowing is done in the month of June - July either through seeds or through fingers separated from old bunch of tubers (which are properly preserved from the old crop or are procured from the forests).
- It must be ensured that some part of the crown / disc remains intact with all the fingers which are to be used for sowing.
- For good crop yield those tubers are considered good that carry an average weight of 8-21g.
- These fingers are planted at a distance of 6 x 6, and a total of 60,000 fingers are required per acre with approximate weight of 400-500kgs. The fingers are sown at a depth of 2.5-3.0cm.
- For better germination, the moisture level in the field must be maintained. The sprouting starts taking place within a week of sowing.

## Interculture - Fertilizer application

- It requires 2-3 manual weedings to keep the field free of weeds. It requires about 15-20 tonnes per hectare FYM and N:P:K application @ 80 : 100:60kg per hectare.

## Harvesting - Processing

- Its above ground part starts yellowing after 3-3 1/2 months of growth and thereafter tubers/ disc fingers keep on maturing in the soil.
- The crop is harvested at an age of 7-8 months when the skin of the tubers turns dark brown. After digging out the tubers they are properly washed and the fingers are detached.
- Longer and healthy fingers are taken for processing (the fingers are peeled out and kept in the sun for drying).

## Storage

- The detached fingers meant for planting in the next season are stored in sand bags maintaining a temperature of 28-31°C and relative humidity of 50-65%.

## Pests and Diseases

No major pests and diseases occur.

## Yield and Economics

- It gives an yield of 50-55 quintals of fresh Musli per hectare and after peeling and drying up nearly 10-12% quintal per hectare dry Musli is obtained.
- Considering a market price of Rs.1000perkg, a net profit of 3-4lakhs may be obtained.