CHAPTER – II

REVIEW OF LITRATURE

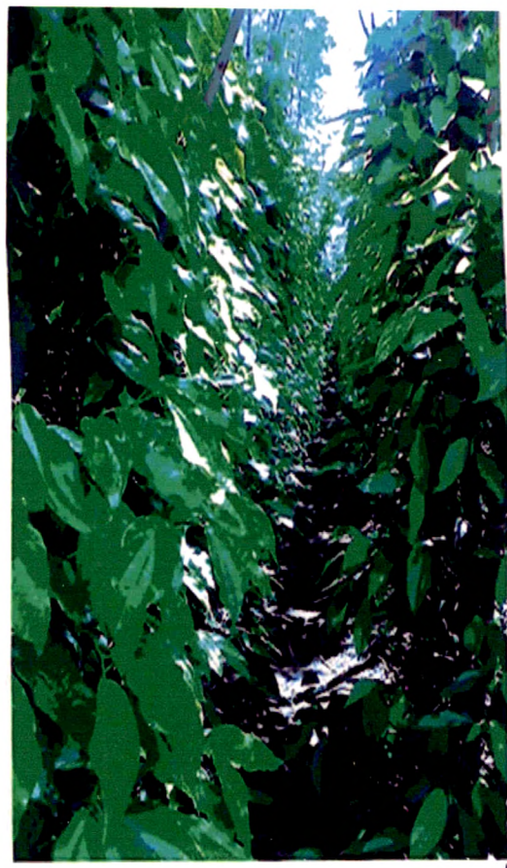


Plate I.
Field photographes of pan Mala
A) Piper betle L. Var. Kapoori.

B) Single Plant of Betle vine .

Introduction

*Piper bet*le is being used in stimulatant, breath freshneer, digestive and in medicines. The beautiful heart shaped green coloured leaves are mastigatory and flavour due to the presence of an essential oil. The information for origin, cultivation, production etc. is as follows.

Distribution in world

Betelvine, Piper betle L, (Piperaceae) is native of Malaysia is cultivated in India, Indonesia, Bangladesh, Sr. Lanka and to some extent of Malaysia, Singapure, Thailand, Philippines and papua New Guinea. In India, it is gown over an area of 40,000 ha. providing livelihood to hundreds of thousands of families engaged in its cultivation and trade. Now it is greatly valued as in the Indian subcontinent. Betel plants greatly used curtailed in recent years in countries like Singapure, Malaysia and Phillipines.

In Bangla state it has a flourishing betel leaf industry, with 12,700 ha. Under betel vine cultivation and annual production exceeds 60,000 tonnes. It exported 345.69 lakh states (Rs.114 lakhs) worth of Betel leaves during 1984-85 to Pakistan, United Kingdom and United Arab Emirates (Amzad Hossain et. Al., 1986).

In Sri Lanka, betelvine cultivation has a history of more than 2000 years. It is cultivated in Valikaman and west division of Jaffna, Kegalle, Gompaha and Mannar districts.

It exports about 3000 tonnes of betel leaves annually to Pakistan but meets with only 50% of the annual requirement of that country. In Pakistan, attempts have been made to grow betelvine since early sixties but its large-scale cultivation has yet not been possible

About 150 farmers grow betelvine in and around Karachi in about 80 hectares. The entire country's need is met with import from Bangla Desh, India, Thailand and Sri Lanka. About 5000 tonnes of leaves worth Rs. 20 crores are imported (Doosani, 1989). The Malaysia usually grew Betel vine in their kitchen gardens.

In Thailand also, betelvine is grown in kitchen gardens. In North Thailand, cu red tea leaves are also rolled in betel leaf and made into a `Meeyang' an equivalt of `beeda' or `gilory' in India. The country exports about 2400 tonnes of betel leaves annually to Pakistan. is not common. In Rangoon, betel leaf is said to be sold at a high premium. Vietnam exports betel leaves to United States. A very strong lasting betelvine race, with highly priced dark leaves, is found in Indonesia and is commonly called `Siren Hitam', only a small group of farmers grows betelvine commercially at some places in the Natol province of South

Africa. It is reported that in Salal near Muscat in Oman betelvine is cultivated in a limited area exclusively for exports as the Betel leaves are a banned item in Arab countries. However, it is sold in black market at a high premium. In Phillippines Betelvine occurs both, a wild and cultivated. In India, betelvine is extensively cultivated in over a dozen of its states and the extent of its cultivation in different states are different.

A) Taxonomy : -

Sysematic Position -

Kingdom	-	Plantae
Division	-	Magnoliopyta
Class	-	Magnoliopsida
Order	-	Piprales
Family	-	Piperaceae
Genus	-	*Piper*
Species	-	*betle* Linn.

B) Morphology :-

Betelvine (*Piper betel* L.) belonging to the genus Piper of family Piperaceae. It is a dioecious plant grown in India as cash crop. Piper is a large genus which belongs to 10 genera and over 1000 species of herbs, srubs and often climbers. About 650 species were described under the

genus Piper. The plant is evergreen perennial, with glossy heart-shaped leaves and white, cat kin and grows to a height of about 1to 5 meter. The vine are mostly herbaceous or woody climbers. Work done so far in betelvine was on different aspects of cultivation. A few reports are also available on sexual dimorphism (Maiti and Biswas, 1991; Maiti et al., 1991), Morphological and anatomical variations of different groups of Betle vine clones (Devi et al., 1992). However morphological architecture of the plant has not yet been fully studied in *Piper betel* L. Betel vine is also dimorphic in branching as in black pepper. Usually vegetative climbing branches used for propagation (pursogloove et al., 1981). The side branches which are reproductive in nature generally do not have any adventitious roots and do not produce any vegetative branches also have glossy and smooth stem surface.

1) Stem morphology :-

The Betel vine has stem - semi woody with dimorphic branching with green colour, (a few branches arise from nodes), it creeping on earth or climbing up on trees or poles. It is swollen near nodes, internodes, elongated.

Sometime stem are cylindrical or bilaterally pressed due to presence of orthotrophic vegetative branches.

2)Leaf Morphology:-

Number of leaves per vine varies from variety to variety. Average number of leaves per varied.

The leaf simple, stipulate, alternate, biforious, petiolale ; the petole is stout, 2 – 15 cm long channelized in basal parts ; Leaf Lamina is smooth 5 – 20 cm long, brood, cordale to obliquely to vine, thick and often unequal, oblique at the base with heart shaped. The venation are multicostate with 5 - 7 prominent convergent secondary veins. Leaves are aromatic, a corminative and a stimulant. It is also an aphrodisioc and an antisepetic. The taste of leaves varies ranging from sweet to pungent, due to the presence of essential oil in it.

Under favourable soil and climatic conditions the leaves obtained are length size and less pungent than those grown under less favourable conditions. According to Satyabrata Maiti and K.S.Shivashankar (1987-1997). All India Co-ordinated Research Project on Betlevine. Also in Betelvine Research Highlights, show sexual dimorphism in Betelvine. In female leaves, are cordate in shape & male leaves are ovate in shape. However, both sexes show variation in length & breadth ratio of leaf of 1.84 ± 0.21 for males & female has 1.26 ± 0.13 length & breadth ratio.

Matured dark green leaves are preferred in the trade for their quality, taste and keeping quality. Matured leaves contain maximum amount of sugars and minerals.

The leaves of Betel vine constitute the economic part of the plant and used mainly for mastication. Owing to high input requirement in the form of high doses of fertilizers, pesticides and labour.

Due to presence of strong aromatic flavour so widely used as masticatory with areca nuts. Stimulation of leaves is due to the presence of arecoline present in areca nuts and the issential oil in the leaf enhances the effect areca nuts. It acts as synergistically upon the central nervous system. According to Suresh Kumar (2000). All essential amino acids are present in betel leaves except some amino acids like lysine, histidine, arginine, they occur in trace amount.

The leaves of 6 to 8 weeks old are matured enough and are harvested without any loss in the quality (K.K. SiNG , k. Johri and V.R.Balasubrahmanyam 1988).

According to Krishnamurthi, (1969) leaves are medicinally important, used in catarrhal and pulmonary afflictions, Also the leaves are considered useful for many diseases affecting human beings reported by (kirtikar and Basu 1958).

3) Inflorescence:-

Betel vine is a cash crop in India. It is a dioecious vine produces orthotropic (vegetative) plagiotropic (reproductive) branches. They differe each other in terms of adventitious roots at their nodes and also have striated stem.(Mithila, J; K.S. Shivashankar and Maiti, S. 1999) It contain male and female flower on separate vine with white catkin inflorescence.

However, Raghavendra Rao and Maiti,(1989). discovery of male and female flowers and fruiting in India opened the possibility of traditional breeding in betel vine. The sexual dimorphism is associated with economic traits (length of leaf and breadth). Great improvement in yield of leaf and crop quality could achieved through heterosis breeding. Maiti et al.,(1992).

The betel vine is a clonal propogated vine crosses between most distinct groups of female x male will yield desirable results and the results could be utilized in short time. Satyabrata Maiti and K.S. Shivashankar (1981-1997). In All India Coordinated Research Project on Betel vine state that flowering & fruiting in betel vine was reported from Bangalore in both the sexes.

4) Male Vine (Male Spike):-

Male spike arising single from leaf base are dense long cylindrical and wavy. The spikes measure 8-10 cm long, 0.5 – 0.75 cm thick. The male spike is very narrow and pendulous. (Aiyer,1947) believed than male plant are only being cultivated in India. This belief was due to absence of flowering, the only to recognize sexuality of plants.

Male vine are under cultivation and they flower under tropical condition which is present in the part of peninsular India and Northern eastern parts of the country.

I) Male Flower :-

Male flowers are small, Stamens 2-3, another is oval without connective having a short stalk. After anthesis the spikes change the colour of yellow and turn dirty green to greenish brown.

5) Female Vine (Female Spike) :

The female spikes arise single from leaf axis and are short, stout, cylindrical and creamy white to light orange in colour. The position of female spike is subpendulous, thicker and longer 5-8 cm. The female spikes are found in isolated places in West Bangal, Western Ghats and Karnataka.

I)Female Flower :

Individual female flower is small, sessile, 5-7 lobed, stigma 3-5. Perianth absent, arranged spirally on the periphery of the fleshy axis. The peltate disc protect flower.

The female spike of Cv. Bangla variety bears flowers with five lobed stigma, while 6-8 stigmatic lobes observed in wild variety of Western ghat. The size of spike are longer and thicker as compared to Cv. Bangla variety.

6) Fruit :-

The fruit is small drope, rarely rounded 5-7 cm in length 2-4 gram in weight, often they sunk in fleshy spike forming nodule like structure. Seeds are 10-20 in each fruit, poor in germination. It is cohering into a long cylindrical mass. Betelvine flowers and fruits are freely in parts of Karnataka in India, and in Malaysia, Indonesia and Philippines. Betelvine flowers and fruits are freely in parts of Karnataka

7) Root:-

The type of root are adventitious, ramous sparsely branching, they spread out in the surface layer of the soil. Also on nodes of stem cuttings

arise adventitious roots. The roots from the nodes of aerial stem, help to climbing organs and gives supports to vine. About 6 – 12 roots arise in a circle around the node of stem and there are two such circles of roots present at every node.

C) Chemical Composition:

The chemical composition of fresh leaves are as according to the data obtained from –

(1) C.S.I.R. The Wealth of India – Raw Materials, Vol. VIII, New Delhi, 1969.

(2) Government of India Ministry of Food and Agriculture, Betelvine Cultivation in India, New Delhi.

(3) Vaidya, V.G. , Sahasrabuddhe, K.R., Khuspe, Vascrop Production and Field Experimentation, Poona, 1972.

(4) Arkeri, H.R.; Anu Patil, H. C. Crop Production Principles and Rules, Bombay, 1959. S.V.S.; Fadake Shri. Y ; Sampa, from Maharashtra Agriculture Directory, Volume I, PUNE, 1954. G. Kashikar, C. G. Indian Botanical History, Nagpur, 197 is as follows :

Sr. No.	Composition	Content	
1.	Moisture	85.4%	
2.	Protein	3.1%	
3.	Fat	0.8%	
4.	Total carbohydrate	6.1%	
5.	Fibre	2.3%	
6.	Minerals	2.3%	
7.	Calcium	230 Mg	
8.	Phosphorus	40 Mg	
9.	Iron	7 Mg	
10.	Vitamin A – carotene	9,600	A.A. International Unit
11.	Rabiaflavin	30 µg	
12.	Nicotinic acid	0.7 Mg	
13.	Vitamin C	5 Mg	
14.	Iodine	3.4 µg/100 gm	
15.	Fired oil	0.7 – 2.6%	

D) Economic Importance:-

The *Betel (piper betle)* leaves are mainly used for chewing for its medicinal properties (Anon, 1969). The leaves are considered useful for many diseases affecting human beings (Kirtikar and Basu 1958).

The Economic Importance of betel leaves is summarized as follows.

The export of betel leaves could be increased manifold by improving the quality of leaves, observing proper hygiene at pre and post harvest stages improving packing method and storage and transport under refrigerated conditions. India's performance in the field of betel leaf

export is insignificant. It has hardly made use of the geographical proximity to markets in the west and south east Asia, the large overseas. Populations of India and Pakistani origin and the relatively low labour costs within the country. India produces about Rs. 700 crores ($250 Million USD) worth of betel leaves per year. Table givers the export figures of betel leaves during the last 18 years. The major betel leaves importing countries are the Middle Eastern Bahrain, Oman, Kuwait, Qatar, Saudi Arabia and United Arab Emirates, Western countries like the United Kingdom, Canada and USA, Kenya and Nepal. Although official figures do not show, Pakistan is also major importer of Indian betel leaves. The annual export of leaves in India is worth Rs. 5 – 15 Million (2.6 lakh dollars) represents a small proportion of the total production of leaves in the country.

(i) Chewing:-

In India and parts of southeast Asia, the leaves are chewed together with mineral lime (calcium oxide) and the areca nut". The lime in pan acts to keep the active ingredient in its free base or alkaline form thus it enabling to enter the blood stream via sublingual absorption. The areca nut contains the alkaloid arecoline, which promotes salivation (The saliva is stained red), and is itself a stimulant. Also miture of some ingreadents like cloves, cinnamon, fennel, peppermint, cardomon addd

with area nut & lime together known as "pan" or "vida." It helps digestion by encouraging salivation on neutralizing excess acid by the lime eaten with it. Betel chewing is considered as a good and cheap source of dietary calcium. Some evidence suggests that betel leaves have immune boosting properties as well as anti-cancer property.

(ii) Medicinal Uses:-

The Betel leaves is used as a stimulant, an antiseptic and breath-freshner. In Ayurvedic medicine the leaves constitute the economic part of the plant and used mainly for mastication.

(iii) All religious ceremonies:-

Betel leaves and arecanut are invariably required in all religious ceremonies of Hindus an are also offerd to guests at the time of reception in marriage and parties. Pan is also a customary (post – perendial) offering at lunch and dinner and other social get-together. Also mixture of some ingredients like Cloves , cinnamon , peppermint , cardimon added with area nut and lime together , known as " pan"or vida.

(iv) Ingredients (Betel leaves oil) :-

The Betel leaves contain betel oil, it is a class of allylbenzene

compounds, it contains chavical (p-allylphenol; 4-allyl-phenol), esteragole (p-allyl-anisole;4 methoxy-allybencene), eugenol, methyl eugenol), and hydroxycatechol. Even it also contain several terpenes and terpenoids which is present in betel oil as well. Also betel oil contain two monoterpenes, p-cymene and torpinene, and two monoterpenoids, eucalyptol and carvacrol. Additionally, there are two sesquiterpenes, cadinene and caryophyllene, also present is oil. The oil is volatile and are antiseptic properties. It is also good for respiratory system and in treatment of bronchitis, cough, cold and chills (Chopra et al, 1958).

(V) Medicinal properties/uses:-

In Malayasia they are used to treat headaches, arthritis and joint pain. In Thailand and China leaves are used to relieve toothache. In Indonesia they are drunk as an infusion and used as antibiotic. The leaves are also used to infusion to cure indigestion as to cure constipation as a decongestant and as an aid to lactation, for dyspepsia, and anorexia, fresh betel leaf with black pepper in the morning before breakfast is recommended. Betel leaf, salt and caraway (ajwain) tucked in mouth before is a remedy used for sleeplessness due to racking dry cough. The leaves also used on children diseases especially catarrhal and pulmonary affections. It is warmed and smeared with mustard oil, are applied in a

pepper, are given to prevent conception (Mudgal et al., 1984). The leaf juice is added to alcoholic beverages to enhance the intoxicating effect. The leaves also tried to 'Kusum' (Schleichera aleosa, oken) oil are used against earache (Mudgal et al., 1984). The warm leaves are very useful on ear swelling and throate swelling.

VI) Agroeconomical aspects:-

The export of Betel leaves could be increased manifold by improving the quality of leaves, observing proper hygiene at pre and post harvest stages improving packing method and storage and transport under refrigerated conditions. India's performance in the field of betel leaf export is insignificant. It has hardly made use of the geographical proximity to markets in the west and south east Asia, the large overseas. Populations of India and Pakistani origin and the relatively low labour costs within the country. India produces about Rs. 700 crores ($250 Million USD) worth of betel leaves per year. Table givers the export figures of betel leaves during the last 18 years. The major betel leaves importing countries are the Middle Eastern Bahrain, Oman, Kuwait, Qatar, Saudi Arabia and United Arab Emirates, Western countries like the United Kingdom, Canada and USA, Kenya and Nepal. Although

layers over the chest. The betel leaves juice is used as an adjunct to pills, administered in the Ayurvedic medicine.

Medicinal properties of Betelvine plant are known to Indian people for a long time. According to the `Susruta Samhita' (6000 A.D.), a great medico-scientific treatise on the indigenous Ayurvedic system of medicine.

The betel leaves contain vitamin B, vitamin C and chlorophyll which is good for teeth. It is supposed to be a tonic to the brain, liver and the heart. The fresh crushed leaves are used as an antiseptic for cuts and wounds and as a poultice for boils by the Philippines.

Vi) Ethnomedicial uses:-

The Betel vine leaves and other parts have a number of medicinal uses by tribal populations and origines of India. The tribals of Khasi and Jaintio hills chew pan (local var. khasi) as a narcotic, which causes swooning and profuse sweating. It also giving warmth to the body during winter. The tribals use the leaf juice as an eyedrop in optic troubles and as an indeliable ink for marketing and labeling garments (Kharkangad and Joseph, 1981). The Karbis of Mikir hills use betel leaf as an a masticatory , which acts as a gentle stimulant and exhilarant (Boothakur, 1981). The leaves also used to cover septic wounds. The roots, with black

official figures do not show, Pakistan is also major importer of Indian betel leaves. The annual export of leaves in India is worth Rs. 5 – 15 Million (2.6 lakh dollars) represents a small proportion of the total production of leaves in the country.

E) Propagation:-

Usually vegetative branches are used for propagation in Betle vine (purseglove et al., 1981).

It is vegetatively propagated through terminal stem cuttings. Size of the cuttings varies from single to many nodes depending upon the place of cultivation. However, better establishment of cuttings was reported from the top three nodes of the vine (Balasubramanyam et al., 1994).

Data on root number and length per node varied significantly among the different varieties *Piper betle* vine.

F) Varietal Improvement:-

The important work on Betel vine is reported from eight Agricultural Universities engaged. All India Coordinated Research Project on Betel vine, at ten centres. These teams are working under The

Director, National Research Centre for Medicinal and Aromatic Plants, Boriavi 387310, Anand, Guirat, India.

The workers have successfully carried out the researches on Crop improvement by germplassm collection, hybridization programme, use of Biofertilizers, *Trichoderma* effects on disease resistance, mycoparasitism in relation to *Phytopthora* foot rot disease. Their further work on insects pests & mites and its management is also in the progress.

At different trial stations the considerable work on betel vine is in progress. However, Patho-physiological work is still remain uncovered at it is vast directions.

Some of the important varieties of betel vine are Deshi Kali, Nalekar, Kurje and Ramtek pan of Maharashtra, Sanchi, Mithu and Bangla pan of Assam and West Bengal, Desi, Desovari, Kapoori, Moghai Banarasi, Calcuttia bongal pan of Uttar Pradesh, Kammera, Koppuri, Madras, local and Mor pan of Tamil Nadu, Nogabally ambadi, karibally pan of Karnataka and Lavangi pan of Andhra Pradesh.

G) Ecological factors :-

Generally cool shade, considerable humidity and continuous regular supply of soil moisture are favourable for Betel vine cultivation

such type of natural climatic conditions are available in South Western coasts of India, Basin tract of Maharashtra and North eastern hilly regions of Assam. In these region betelvine is grown in she shades of forest grown by areca nut gardens . In other states artificial structures such as temperature, humidity conditions and shade are created for Betel vine cultivation.

I) Temperature:-

Very low temperature causes early shading of leaves. In Maharashtra state besides Basin tract which provide natural conditions for betel vine cultivation, it is grown in Pune, Satara, Sangli, Ahmednagar, Amravati, and Nagpur district where annual rainfall is from 400 to 1,000 mm and temperature range between 10°C to 44°C. Irrigation supply and soil type

Betel vine is perennial crop. It requires liberal supply of irrigation water throughout the year. The soil is well drained and fertile type is good. The Betel plant does not tolerate saline and alkaline soil conditions. Light reddish and medium block soils which have good drainage containing pH of 6.5 to 7.5 suitable for crop growth. It thrives best on red laterites and old and new alluvial soils.

H) Cultivation practice

Rotation

The land under the betel vine crop needs rest or a change of crop. It is grown in rotation with a variety of crops of sugarcane, turmeric in Andhra Pradesh, vegetables and banana in Maharashtra, surgacane tobacco, paddy and chillies in Karnataka and paddy vegetables and tapioca in Kerla. In Uttar Pradesh more emphasis is given on mixed cropping with parwal and kundry. On the other hand Dr. Mann that crop like wheat, onion, etc come up very well after a Betel vine crops.

I) Preparation of land

There is no special need for preparation of land for betel vine. In Assam and Kerala states it is taken as an associated crop with areca nut. It contain round pits of 60 to 120 cm diameter and 30 to 60 cm depth are dug out at the base of the supporting trees and filled in with top soil mixed with wood ash and leaf mould. Since the crop is very sensitive to changes in climatic conditions, raising of wind breaks and provision of supports and shade plants or rooting are very essential. In piains of Andhra Pradesh, Karnataka, Assam and Maharashtra, the land is properly selected, ploughed and harrowed several times. Also about 35 to 50

tonnes of Farm Yard Manure is applied per hector and mixed with the soil.

J) Layout

There is a large variety of layouts used for betel vine cultivation. Betelvine in plantation and forest areas shares the same arrangements provided to the main plantation. Crops like areca nut palm. However, in plains a very careful and elaborate planting is needed. The some layout is based on considerations of soil, climate and irrigation facilities while others are merely on tradition.

The layout requires water channels (dands) are opened at the upper boundary of the plot after the monsoons are over and the main drains (nijars) parallel to the water channels are opened at the lower boundary of the plot. Between these, at right angles, subsidiary channels and drains are opened 4 meters apart from each other, 3 meter long, 15 cm wide and 15 cm deep furrows , harals are opened at right angles to the sub channels and the sub-drains. A distance of half a meter is kept between two harals. One hectare of land requires about 2,500 harals.

Banana sucker is planted after layoutis ready. Every fourth harals contain space between 2 harals. About 625 banana plants required for one hectare. Betelvine cuttings are planted 15 cm apart in the same point on

the two sides of the haral. The vines are trailed on dead supports of (Karvi acoso) there are no any live support are used.

i) Layout in Maharashtra

The layout in Ahmednagar, Satara and Pune districts of Maharashtra is more or less the same with very minor variations. The field is marked out and the land is leveled perfectly. It is divided in four equal quarters by one meter wide paths called chamans running across the field at right angles to each other. Each quarter is known as chowk has five to six sub-groups is chiras containing 15 to 18 beds each. Each bed is 3 to 4 meter long and 1.5 to 2.0 meters wide. The irrigation facilities are made by network of channels and subchannels.

K) Support System

Betel plant requires support system to grow well for, this specific plants are planted near the vine. In middle of June the plants like *Sesbania aegyphiaca* (shevri), *Erythrina indica* (pangara) and *Moringa prerygosperma* are planted. In order to provide for a *prerygosperma* are planted. In order to provide for a strong wind break and cool shade, stout branches of pangara taken from an old plantation are pointed at every 1.5 to 2.0 meters along the border of the garden Mulberry

cuttings are also planted in August or September. Planning of vine done in September and October. Planning of shade trees and supports starts from June. Plantation suckers are planted on the sides of the beds at the rate of one per 5 to 6 beds in a row. Shevri and Pangara later provide support to theBbetel vine creepers.

L) Planting Methods

The Betelvine plant is propagated by planting mother plant or vegetative propagation. The vigorous apical buds and nodal adventitious roots are selected and planted at the base of the supports by digging small drenches. The length of sets is 35 to 45 cm each having about 6 buds. The number of sets planted per hectare is about 25,000 to 35,000. the longer sets are coiled around and then pulled with the terminal sprouts facing towards the support. If the set is small, it is buried in the trenches keeping the half above ground.

M) Trailing

Trailing is done when vine is begin to spout and creep along it trail by tying vines loosely along the standards at every 15 to 25 cm distance with banana fibre. The process is done every 15 to 20 days, depending upon the growth of vines. The vine must be free from weeding and

stirring the soil. The vine supports, they strike out the adventitious root and climb up.

I) Care before Planting

The betel plant is very sensitive. It requires very care before planting and after planting. It requires proper irrigation and soil moisture. The beds are irrigated by keeping a basket with about 10 kg of copper sulphate. The soil moisture is brought to field capacity, it around the sets is pressed to avoid aid process and to help the sets establish good contact with the soil and strike roots early. Irrigation are supplied as usual in light flow. The number of flow irrigations varies from 60 to 90 a year in different localities. Morning irrigation is preferred to irrigation at any other time.

II) After Care

After the establishment of vines with a period of 3 weeks the plantation requires a constant attention by an expert worker. The care of vine should be necessary at the time of thinning, pruning, filling in the gaps of vine, earthing up and topdressing, irrigation , drainage, and lowering of vines. Before the vines establish and began to creep, the stems of the live support are kept smooth by cutting down side branches

upto a height of 1.5 to 2 meters a height of 4 meters to encourage branching and it provide more shade to betelvine.

N) Lowering of Vines

Lowering of vines to the ground level done at least once in a year. When the vine reach height of 3 meter their rigors to produce normal size leaves yet reduced and they need rejuvenation. Lowering is done mainly in spring time. In Western Maharashtra, lowering is done in April-May. And in Vidarbha lowering is in October. The vine is carefully in the form of 8 digit mode and are buried in the drenches dug near the supports. The coil of vine is earthed up firmly leaving the top shoob to climb up on the live supports again it need new trenches dug nearby the previous ones. Immediate light irrigation need after lowering.

O) Manuring

Betel plant need manure, they provide nutrition to the plant and maintain a good structure of the soil near the root zone. Manures and fertilizers are generally applied during the preparation of land and at lowering time. Generally, FYM, sheep manure, tank slit, oil cake and other organic manures like fish manure are applied. The quantity of manure applied per hectare and its time and method of application vary

considerably all over India. The dose of FYM varies from 25 to 40 tonnes per hectare. It is also replaced by other type containing fertilizer mixtures. Fish manure and oil cake.

P) Harvesting Process

Harvesting process in betel vine plane need favourable climate and good cultivation practices, it grow rapidly and produces leaves of better quality. The period of picking starts 3 to 6 months after planting in basin area of Maharashtra., Kerla and Andhra Pradesh. In arched tracks it is after about a year. Harvesting of betel plant depends upon the market demand, value once the harvesting is started it continues every day or twice or thrice in a week. The interval of harvesting leaves from the same plant varies from 15 to 60 days. It need expert hand for picking the leaves. In some areas artificial thumb nails are used for picking the leaves. The good quality leaves are cut along the petiole graded and packed by packages prepared from banana sheaths and made ready for shell.

Grading

The grading of betel leaves is done in various ways.

(1) **Hatwan** - The leaves on the branches called Hatwan , they are of best quality.

(2) **Agwan** – The leaves arise at the nodes of main stem colldes Agwan, they are of medium quality.

(3) **Modwan** - The leaves which are arise on the rest from any part of the vine is Modwan, they are suppose to be inferior quality.

Grading of leaves in Maharashtra

In some areas of Maharashtra the leaves are graded according to their maturity on the vines and colour of leaves.

(1) **Navati** - New leaves of betel plant are known as Navati.

(2) **Parati** - The leaves obtained from the second flush.

(3) **Triti** - The leaves obtained from third flush.

(4) **Junwan** - The leaves which are kept on the vine for a longer period to mature and till good market conditions are obtained, these leaves are old and dark green colour.

Q) Bleaching

In Betel plant leaves are bleached which possess many medicinal properties. A large portion of the leaves is consumed fresh but a small portion of it is bleached. The bleached leaves have better aroma and taste and it contains more amount of reducing sugar and essential oils as compared to fresh green leaves.

In Pune area of Maharashtra state special bleaching chamber are presnt. The mature leaves are trimmed in chamber. The chamber is an ordinary galvanized iron tin cylindrical shape and open from both sides. The chamber are filled with leaves, it is covered with a gunny cloth. The leaves are carefully examined on every alternate day to see the progress of bleaching and to remove the rotten leaves. The process requires 8 to15 days in summer and about 15 to 25 days in winter. The bleached leaves find a ready market and also fetch to a good premium. The chamber can accommodate 16,000 to 20,000 leaves. Bleaching also brings about degradative changes in the leaves besides yellowing. Non-reducing sugars, starch and chlorophyll degrade during the time of bleaching. (Book Betelvine).

R) Yield

The betel crop yields obtained are less in the first year. It is maximum in the middle period of life and gain it is less at end. The betel leaves yield ranges between 50 to 75 leaves per hectare in Bassein area where the economic life of the crop is 2 to 3 years. Yield of betel leaves varies from different part of country. In Maharashtra , containing other parts yield ranges between 15 to 25 lakh leaves per hectare while the economic life of betel vine is about 6 to 10 years old.

S) Processing

Majority of betel leaves are consumed fresh as a masticatory . however some countries are made use of leaf for favour. In parts of Sikkim, liquor is made with betel leaf flavours. Even a special brand of whiskey with betel leaf flavour is also marketed. The Central Food Technological Research Institute, Mysore introduced pan Nectar – a ready made betel guild.

In recent years, `pan josh' , a chewing gum with betel leaf flavour has been widely marketed in the country. The leaves contain essential volatile oil is distilled and are used commercially for flavouring cantechanaries such as pan maza, pan pasand and blending perfumes. Intensified technological research needs to be undertaen to develop newer products from betel leaves which are more and more beneficial to human life.

I) Cultivars and different varieties of Betelvine Plant

More than one hundred fifty types / varieties of betel plant are grown by cultivars and recognized by traders in India. Three major cultivars viz. Bangla , Meetha and Sanchi are commonly grown in West Bengal.

On the basis of the position of widest region of the lamina in relation to trisection of laming axis, Ganguly (1981) has recognized 15 types under the (V. Bangla Differences in taste, texture, morphology and histogenesis do exist in these types but they are not at the taxon level. Das and Chattopadhyay (1984) have classified the 17 types, grown in Midnapur district of West Bengal, into (Vs. Bangla, Meetha and Sanchi, on the basis of morphological, anatomical, micrometrical and phytochemical parameters.

Narayana Reddy (1984) has grouped 55 varieties, collected from different parts of the country, into `pungent' and `non-pungent' groups. In peninsular India important commercial varieties Betel vine grown are Kapoori, Sanchi and Bangla cultivars.

Following are brief descriptions of Betel vine five main distinguishable cultivars are given below.

(1) Bangla Variety

Bangla comprises about 35 types, the most important and popular are `Desi Bangla, 'Ramtek Bangla', 'Calcutta Bangla', 'Aimal' and 'Navakalopatta', it is mainly cultivated on commercial scale in Orrisa, West Bengal, North East region, Utter Pradesh, Bihar and Kerla. Vines grow vigorously, 7 – 9 prominent secondary veins are spread in curve.

The petiole length is 6-10 cm. While Calcutta Ramtek and Navakalopatra have long petiole of 8.5 x 11.0 cm – 15.5 x 19.0 cm is light green, with yellowish tinge and high pungency.

Bangle leaves are dark green in colour and slightly pungent 'Maghal' leaves ar small in size, non fibrous and tasty. The matured leaves are also soft, is in general large, cordae to roundish , with lamina much below the middle point, entire and glabrous , petiole prominent, auriculate base, apex is acuminated short fibrous, taste is pungent, eugenol content and oil is the maximum up to 82.1.

(2) Variety Desawari

The Desawari culture is most common in Madhya Pradesh and Uttar Pradesh are about four types. `Des, Desawari, `Manoba Desawari, Malvi Desawari' and `Karubali' – all very well known. The leaves are long cordite to moderately ovule (R-value 1.47 - 1.49), short, pointed and acuminate; curved apex, a important characteristic of this variety ; leaf lamin glabrous with less conspicuous basal lobes and 4-6 secondary veins running close to the midrib.

As compared to the Bangla, it has a slightly worm, light sweet taste, essential oil contain anethole content and it is comparatively low about 7.2%.

(3) Variety Kapoori

The variety Kapoori contain about 25 types under commercial cultivation. Mainly in Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Maharashtra. Some common types are 'Vellai Pacchaitkkadi', Gangari, Sankara Kapoori, Satyavaram", Doma, Ramtek Kapoori etc.

The vigorous vine contain leaves narrow, ovule (R - value 1.5 – 1.59), lamin thin, entire margin, light yellowish to light green in colour, globules and soft in texture. Sometimes less fibrous and acuminate apex. The leaf base is not lobed as in Bangla. The leaf has a prominent midrib with 4-6 secondary veins, run almost parallel to the midrib.

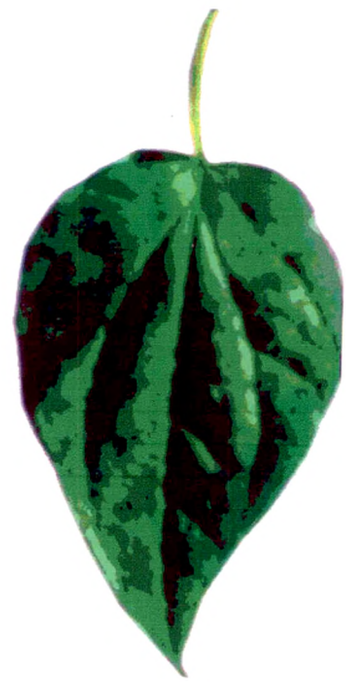
The leaf contain characteristic Kapoori aroma and is less pungent, terpenyl acetate content in its oil is maximum 21.98%. thus cultivator gives the highest yield.

(4) Variety - Meetha

This variety Meetha is mainly restricted to Midnapur and Howrah districts of West Bengal and is of two main types are 'Galpala' and 'Thackpala'. The leaf is thick, waxy, cordare to broadly ovate, colour is dark green with pale yellow spots ; short and pointed apex with secondary veins present. The basal sinus is less conspicuous, base is slightly asymmetrical.

Plate II.
A).Photographes of Control vine of
Piper betle L. var. kapoori.

B) Single leaf.



The size of leaf is more or less uniform (R. value 1.44 – 1.49). The leaf has a characteristic fennel (Saunf) like aroma, due to presence of anethole (19.3%). The essential oil is sweet, palatable taste due to this taste, they are known as `Saunfia' or 'Meetha' pan.

(5) Variety - Sanchi

The variety Sanchi is cultivated throughout the country. It has about 15 types. The most well known is `Pachhaikodi', `Kuliedu', `Kare', `Kaker' and `Kalipath'.

Leaves are medium to large (9.0 – x 5.5 – 21.0 x 13.2 cm), narrow ovule, with a long base. The lobe are less prominent than of Bangla. Margin of leaf are entire, venation reticulate, multicostate, with 6 - 9 prominent divergent secondary veins. Petiole is short (6.5 – 9.5 cm) channeled unlike other cultivars, it run close to the stem and forms an angle. The taste of leaves are pungent fibrous with dark green colour.

J) Area under betelvine cultivation in different States in India

Name of States	Area in Hectares
Andhra Pradesh	2900
Bihar	3200
Gujarat	200
Karnataka	8750
Kerala	3300
Maharashtra	2700
Madhya Pradesh	1250
North Eastern Hill region including Assam	3000
Orissa	5000
Rajasthan	50
Tamil Nadu	5544
Uttar Pradesh	2000
West Bengal	3000

In the state of Maharashtra about 2700 hectares of land is under the cultivation of Betel in the districts like Thane, Satara, Sangli, Kolhapur, Nagpur, Amravati. In other part of Maharashtra the yield ranges between 15 to 25 lakh leaves per hectare, the economic life is 6 to 10 years.

The systematic position, morphology and cultivation practices etc.

I) Betel Leaf Export

Year	Quantity in M.T.	Value in Rs. (Lakhs)
1968-69	208	5.65
1969-70	210	5.80
1970-71	372	9.40
1971-72	461	11.82
1972-73	391	13.98
1973-74	209	7.16
1974-75	253	10.84
1975-76	249	14.43
1976-77	304	22.92
1977-78	932	80.07
1978-79	1,347	132.25
1979-80	402	34.29
1981-82	435	40.02
1982-83	574	61.62
1983-84	740	82.00
1984-85	1,116	151.00
1985-86	717	110.00
1986-87	582	91.90
1987-88	814	125.41
1988-89	1063	164.46
1989-90	N.A.	N.A.
1990-91	884	148.01

Monthly statistics of Foreign Trade of India.

(Export and Re-export Piper Betel Government of India.)

K) Pests and Diseases

Betel vine is very sensitive and delicate plant. It is attacked by several pests and diseases. The most common and important pests are (1) Betel vine bug (2) Mealy bug.These are controlled by using different pesticides and insecticides containing queserol, DDT, buguldin.The Betel vine bug can be controlled by queserol 550 spraying at 50 P.C. water dispersible DDT at the rate of 1 kg in 250 liters of water has been found to be very effective in Basin area. The mealy bug can be controlled by spraying with busuldin which is very effective.

l) Diseases

Following major diseases of *Piper betel* are given below.

a) Foot-rot and Leaf-rot Collor or basal rot -	*Phytophthora spp.* *Phytophthora nicotianae var. nicotianae* *Van Breda de Hann.* *p. parasitica var. piperina Dastur* *p. plamivara, (E.Butler).* *p. Capsici* *Sclerotium rolfsii Sacc.*

2)	**Anthracnose**	-	*Colletotrichum piperis petch, C. dasturi Ray, C, Capsici (Syd.) Butler and Bisby Glomerella Cingulata (Stonem) Spauid & Schrenk*
3)	**Powdery mildew**	-	*Oidiium piperis uppal, Kamat & Patel*
4)	**Fusarium wilt**	-	*Fusarium spp.* *F. equiseti (corda) Sacc.* *F. Oxysoporum Schlecht* *F. moniliforme (Sheldon) Snyder & Hansen*
	Fusarium leaf spot		*F. Solani (Mart). Snyder & Hansen* *F. Semitectum Berk & Ray*
5)	**Leaf gall**	-	Synchyrium piperi mundkur & Mhatre
7)	**Bacterial leaf Spot**	-	*Spot – pseudomonas betlis (Raghunathan) Burkolderr* *Xanthomanas compestris pv. betlicola (Patel et al.) Dye.*
8)	**Leaf spot in storage**	-	Unidentified species of bacterium
9)	**Tip burn**	-	Physiological disorder

II) Major diseases Of *Piper betel L.*

Piper betel plant is severely affected by two major diseases such as Leaf and Foot Rot disease of pan.

a) Leaf and Foot Rot

The foot rot leaf rot, and wilt disease of "pan" (*Piper betle* L.) is a serious disease in Bengal and Madhya Pradesh and very often has been a limiting factor in successful production at this crop. The disease has also been reported from various other "pan" growing tracks of the country, especially from Eastern Uttar Pradesh where it sometime causes extensive damage. In Thane district of Bombay it practically annihilated the industry during 1930-35,

Symptoms

The first symptoms of the disease are a darkening of stem which may be preceded by a loss of colour of leaf and dropping of the tender portions. Yellowing of leaves starts from bottom to upwards. At this stage root system is found undergoing rotting and the stem may break at any point near the ground level. Wilting and dropping of the leaves, sometimes appearance of large black spots or blotches on the leaves covered with a delicate fungal growth, are also common. The disease progress affected tissues may be exposed, appearing shrunken and slimy. Actually disease starts much before the symptoms appear on the leaves and above ground stem. The infected leaves rot during transit and storage. By the time the plant is dead only two or three internodes may be involved.

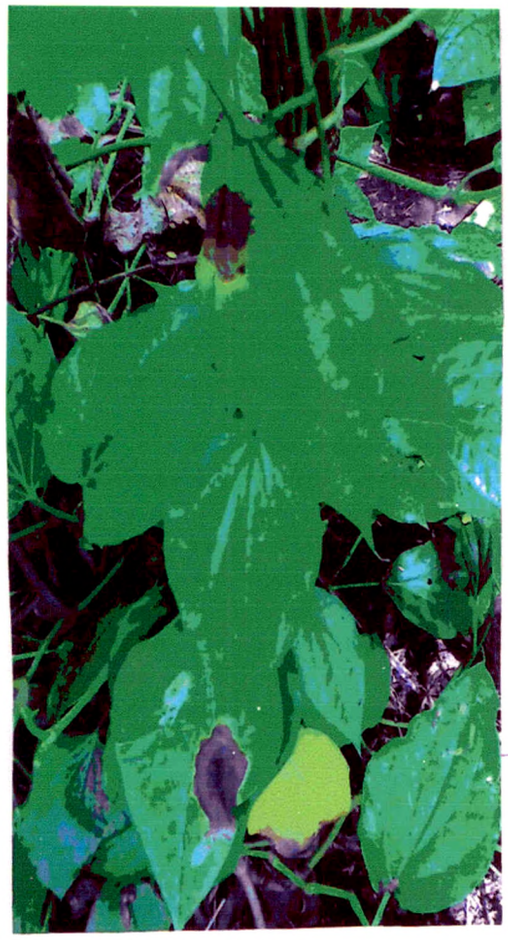


Plate III .
Photograph of Infected vine of Piper betle L.

A) Var. Kapoori. by Phytophthora parasitica Var. piperina .

B) Single leaf showing Infection.

Causal Organism

Phytophthora parasitica var. piperina Dastur. Sub-division - Mastigomycotina

Order - peronosporales . Family -Pythiaceae

The disease is now recognized that the fungus is the major cause of the disease and that it parasitize the roots underground stem and leaves of *Piper* betel and roots of *Piper longum*. The fungus contain hyphae generally intercellular, sometimes intracellular. It contain sparangia pear shaped and broadly ovule with a prominent papilla, measuring 30-63.3 x 20.4 – 40.8 microns. The zoospores ore motile and bean shaped, biflogellate ; resting spherical measuring 2.2 – 5.7 microns in diameter. Also chlomydospores are present. The fungus contain two sex organs. Antheridisum and Oogonium. The Oritheridia are hyaline, thin walled, persistent and amphigynous ; one antheridium per Oogonium. Oogonia at first hyaline, smooth and thin-walled and spheroidal or very pale yellow coloured measuring 17.8 – 53 / microns (average 20 / microns), after fertilization oogonia are thick smooth, rough walled yellow or yellow brown in colour, measuring 20.4 – 40.8 (average 33.4) microns. The fungus can grow well in culture is 30°C. Maximum sporangial development in culture is at 30°C, none at 5-10°C and 37-40°C. In nature of sporangia develop only at 20 – 31°C when the relative humidity is 100

per cent. The maximum growth disease of the fungus occurs at 22-24°C., the soil temperature favouring maximum disease development also maximum liberation of zoospores found at 21-23°C and free water with 100 percent relative humidity.

Disease Cycle

The fungus is soil borne facultative parasite. Movement of contaminated soil also helps in the destruction of the primary inoculum. Secondary infection is caused by abundant sporangia produced on the leaves and stems and disseminated by rain or irrigation water. Low lying, ill-drained soils with excessive free moisture near the roots of vines are highly favourable for development of the disease. The disease is destructive during rains and only sporadic in other seasons. Heavy doses of organic manures and irrigation favour rapid infection.

Control measures

Cutting for planttion purposes should be selected from healthy orchards, as there are chances that the cuttings might be contaminated with the pathogen. All the affected parts of the plant should be carefully collected and burnt.

Spraying the foliage with fungicides before and during rains gives effective protection on the basis of experiments conducted by Vyas and Chaurasia (1976) cuttings are also dipped in 1% streptomycin solution and 1 % Bordeaux mixture is sprayed twice a month. The disease can be controlled almost totally.

Dasgupta et al. (1988) showed that fosety – Al and BM were effective in controlling *Phytophthora* rot of betle vine. Nag et al. (1993) reported that copper oxychloride dithio-carbomate (Cumon – L), BM and Chloroshalonil (Kovach) were effective in reducing Foot-Rot of Betelvine.

However, considering the mode of consumption of leavers, attempts were made by many workers to replace application of fungicides with biocontrol agents. Earlier work on biocontrol of stem rot disease (Tiwari and Mehrotra, 1968 ; Mehrotra and Tiwari, 1976) showed that dipping of cuttings in a *Trichoderma viride* cell suspension effectively reduced the disease. Similarly, use of corn straw and fil oil cake (*sesamum indicum*) also reduced the disease (Mehrotra and Tiwari, 1976). D'souza (1998) from a comprehensive field trial reported significant reduction of disease with an isolate of *T. harzianum*.

L) Use of *Trichoderma* in control of Betel vine diseases

Trichoderma is a member of Deuteromycotina are common soil inhabitants and are rarely plant pathogens. The species of *Trichoderma* show potential as biocontrol agents of plant pathogens in commercial agriculture (Chet, 1987; Harmon and Hadar, 1983; Harman et al; 1989 ; mPopavizas ; 1987; Chet 1990). It is also used for production of enzymes in industrial microbiology (Ryu and Mandels, 1980 ; Chet, 1987). The potential of *Trichoderma* as a biological control agent was recognized as early as 1934 by R. Weindling 1934, 1937. In 1971 Dennis and Webster published a series of papers and antagonism of *Trichoderma* and implicated the role of volatile and non volatile antibiotics in antagonism. The *Trichoderma spp.* Have interesting features of antagonistic properties like cell wall degrading enzymes with high competitive ability abundant in soil and on organic matter and fast growing fungi.

Trichoderma spp. Are producers of hydrolytic enzymes including cellulases and possess antagonism against large number of phytopathogenic fungi. Therefore, mycoparasitism and antogonism. Although antibiotics produced by *Trichoderma spp.* Have implicated in the pathogens suppression (Simon and Sivasithamparam) 1989), mycoparasitism by species of *Trichoderma* has also been proposed to be

Plate V.
A).Photograph showing Trichoderma treated Infected l vinesof Betle vine by Foot- Rot disease.

B).Single Leaf of Tricoderma treated Betel vine

involved in the antoganism of many soil-borne pathogens (Chet, 1987; Niranjani et. Al., 1990, Sivan and Chet, 1989, a. b).

During mycoparasitism chemotrophic stimuli are secreted by the host hyphae which attract *Trichoderma* towards them. (Chet, 1987).

However, the nature of these chemotropic substances and their involvement in antagonism is not well understood. The most important species. Of *Trichoderma* are *T. viride, T. harzianum, T. Kanningii, T. humtum, Trichoderma viride and Trichoderma harzanium*. Two are used in large scale to control of all diseases in agricultural crop plant.

The Biennial report of All India Networking Research Project on Betel vine by NRCMAP of Central Government Council (2004-2006) also throws light on use of *Trichoderma* in control of *Phytophthora* disease of Betel vine in India. However, their work is related to development of disease resistance verities germplasm and nutritional status. The enzyme studies in relation to antagonism properties of *Trichoderma* with *phytophthora Spp.* Is not worked out so far.

The studios of Dwaan and Sivasithamparam (cited in Ghisalberh et. Al., 1990) also indicated the effectiveness of *Trichoderma harzianum* against take all diseases of wheat in greenhouse due to the presence of pyrone antibiotics. Almassi et al., (1991) also demonstrated the antibiotic activity of I. Harzianum strain 71 atainst G. Grominis Vor.

Tritici. Bruce et al., (1984) found that *Trichoderma spp.* Including *T. harzianium* controlled the growth of wood rotting basidiomycetes (Lentinus lepideus).

The study has been done by Riquout et al., (1998) with few strains of T. viride and *T. harzanium* in response to the purified dead cell wall of *Rhizoctonia* solani. Assay of enzymes produced and Trichoderma has also been done by Huggest and Nixon (1957) Reissig et al. (1989).

The Field control of sclerotial stem rot of peanut was achieved in Israel by *T. harzianum* (Chet et al; 1972). Backman and Rodriguez - Kabana (1975) have successfully usd *T. harconium* for biological control of soften blight of peanunt on field scale. Soil inacula of T. harzanium prevented all isolates of S. roltsii from establishing in soil and causing infection in onion and chilli during the field work.. Joilloux and Froidetand (1987) found that 11 strains of *Trichoderma* belonging to T. *hamtum, T. harzianum, T. Konningii, T. longibrachiatum and T. viride*

I) *Trichoderma Viride*

Different species of *Trichoderma* were also used in controlling soil borne disease Mehrotra and Tiwari (1969) obtained complete control of foot rot and root rot of *piper betle* with the help of *T. viride* Mall and

Mall (1980) worked on same aspects of biological control of diseases of *phaseolous lunatus*, *pisum sativum* and potato caused by *R. Solani.* They used to isolates of *T. viride* for control of seedling infection of the above crops.

Trichoderma viride has also been proved to be effective in controlling root rot of wheat causerd by S. rolfsii (Dubos and Built, 1981). Grey mould disease of vine caused by Botrytis cinerea has shown a success in control if France and Italy when treated with Trichoderma spp.

Due to hyperparasitic ability o *Trichoderma spp.,* their establishment on the floral parts further limits the development of grey mould on the branches (Dubos and Bulit, 1982). They further investigated the effect of treatment of *Trichoderma spp.* On the build up of infection in the field and found a decrease in number of on the branches.

Recently WU (1991) found control of scleprotinia rot of sun flower and chrysanthemum by spraying spore suspension of T. Viride. Fronsma and Dennis (1977) observed that spraying the straw berries with conical suspension (10% conidia /ml) of *T. viride* and *T. harzianum*, three times during flowering period, reduced natural

infection caused by B. cinerea from 21 to 12% D'Ercole (1985) obtained satisfactory control of above disease with *Trichoderma viride.*

Other species like *T. Konningii* and *T. hamtum* also gave some good result towards bicontrol of a few disease. Jariwala et al. (1991) also observed in vitrol and in viva the inhibition of D. oryzae , the causal agent of brown spot disease of rice in terms of lesion size and number, when metabolite or spore suspension of T. viride was sprayed on the leaf of rice. Singh and Cholan (1974) studied the antagonism of *Trichoderma viride* against some pathogenic fungi on groundnut seeds and found that the antagonist was highly effective in protecting the seeds from seed rot.

Lifshitz et al. (1986) hav studied the application of conidia of isolates of

Trichoderma harzianum or *Trichoderma Koningii* of pea seeds and observed a reduction in the incidence of pre-emergence damping. Off of pea, Banu et al. (1990) observed the effectiveness of seed with *T. horzianum* and *T. viride* in reducing the incidence of seed borne disease in chilli. Similarly, control of dry eye rot of apple was also obtained by T. Pseudo-koningii and *T. harzianum* (Transmo and RoO, 1977).

Trichoderma species have been used in combinations with other fungi or bacteria for integrated control of some diseases.

a) Mode of Application

There are different techniques have been developed for the accurate application of *Trichoderma* and other antagonisis for control of plant diseases (Kommedhal and Windels, 1981). The easiest and most direct approach of application is to trench the soil with suspension of *Trichoderma* propagules.

M) The other methods which were adapted are :

(1) To add in the soil colonized grain bran (Wells et al., 1972), Wheat straw composed hard wood bark (Holtink, 1980; Nelson and Hoitink, 1983), Pellet Formulation (Ricord, 1981), Colonized corn leaf meal and sugarbeet pulp, colonized inert granules of diatomaceous earth impregenated with some food base (Backman and Rodriguez – Kaboua, 1975)

(2) Dipping the roots of the plants in the propagule suspension of Trichoderma spp. (Dutta 1981, Jordan and Tan, 1978)

(3) Addition of *Trichoderma* spores to soil with a fertilizers (liquid) with seedling gels used for fluid drilling of small seeds (Fisher et al., 1983 ; Walker and Commick, 1983),

(4) Incoporation of *Trichoderma* through sprinkler irrigation (Lewis and Papavizas, 1983)m

(5) A dry formulation in the form of dry powder with pyrox as a carrier (Papavizas, 1985).

(6) As propagule encapsulation either alone or with nutrient carrier (e.g. bron) (Lewis and Papavizas, 1983; Walker and Commick, 1983),

(7) To grow *Trichoderma* in large amount on solid media (ground annual rye grass seed) and to add it in the soil with food base (Wells et al., 1972),

(8) As bare conidia, following fumigation or a selective treatment such as soil pasteurization (Lacke et al., 1984),

(9) As a fermented biomass formulated as powder, slurry or alginotes (Lewis and Popavizas, 1983).

(10) Application of *Trichoderma* in soil in form of treated seeds, a suspension of *Trichoderma* propagules.

It is an alternative approach to introduce *Trichoderma* in soil. This method requires smaller amount of biological materials (Harman et al. 1981) and

(11) As the broad cost application of wheat bran / peat preparation (Sivan et al., 1984).

There are different ways in which the foliar antagonists are applied to control aerial pathogens. Direct application of *Trichoderma* to aerial plant parts at pruning, in advance of decay fungi, is a common method, Groselaude et al. (1973) controlled the silver leaf disease of plum by applying conidia of antagonist to wounds during cutting by means of special pruning shears. For the control of silver leaf disease, *T. viride* impregnated silvered plums, peach or nectarine trees. Dubos and Ricord, 1974). Hunt et al. (1971) developed a method in which *Trichoderma spp.* Was formulated in chain saw oil (motor oil) and successfully inoculated in pine stumps during tree cuttings.

N) Scope of present investigation.

Piper betel is most delicate plant attracted by several pests and disease. viz. Foot, Stem & Leaf Rot by *Phytophthora* Spp., Marginal blight, Basal & Charcoal rot, Wilt, Bacterial leaf spot, Stem rot & Root knot. The most important foot-rot disease is caused by fungus Phytophthora parasitica Var Piperina which is dangerously affecting the leaf yield (Ma Rac 1934, Dastur 1935). Spraying of leaves and soil with fungicides before and during rains gives effective protection from the disease. However non chemical method of *Phytophthora* management in betelvine would to be

very soft. The extent of losses may vary from 5 – 90%. (Dasgupta and Sen; 1999). It varies during the winter and very rarely occurs in the off-season.

Mehrotra & Tiwari (1969) have studied control of foot rot & Root Rot of *Piper betel* by using *Trichoderma viride* . Hence use of *Trichoderma spp.* Spray on leaves, stem of foot zone soil along with proper media was adapted by Betle cultivars in Maharashtra and other states. It is observed that *Trichoderma* play important role in controlling root – rot disease in piper betel without affecting leaf production, quality, taste and market value of the crop.

The betel vine is important cash crop and commercially grown in India. The Government of India has started the research on crop improvement, production, disease management with regards to the Betel vine Cultivation in India. Severals Research Stations were established which carries out the research work from 1981. In Six research centres like Dharwad, Bhuvaneshwar, Chinthalpudi, Vellore, Jabalpur, Rahuri etc. upto date there are 11 Centers are working for Betel vine in 1981 to 2006. The main objects were Epidemiology and control of various Betel vine diseases and also to collect and maintain the disease free germplasm of all the clones in the country.

This All India Coordinated Research Project is now working and following Xth plan of the Government successfully by developing a All India Networking Research Project on Betel vine throughout all centres in India.