CHAPTER 3
CULTIVATION TECHNOLOGY
OF BETELVINE
INTRODUCTION

The betelvine cultivation needs considerable investment and intensive care. Due to heavy investment and strict requirements, the crop is cultivated in small scale. The cultivation of betelvine is an extremely lucrative job but it requires an intimate scientific knowledge with respect to important factors like temperature, humidity light supports planting season, method of planting and its nutritional requirement, type of soil, aeration, water supply and different ecological conditions in which they are grown. Due to it's delicate nature and special requirements for the growth and maintenance, betelvine crop is grown in cool shady tropical forest ecosystem on live standards with adequate soil moisture or artificially made conservatories locally known as barejas. To make easy the study of cultivation technology of betelvine some steps are given below:

Soil

Betelvine is grown in different types of soil in various parts of the country. The betelvine requires exceptionally well drained and fertile soil that is rich in humus and other nutrients usually it prefers alkaline soil for good yield. Clayey loam soil which is rich in organic matter and heavy good drainage is considered as best suited for the cultivation of betelvine.

Plantation

Before starting plantation two things are required for proper attention:

(a) Selection and preparation of the land.

(b) Construction of bareja,
(a) Selection and preparation of the land

The ground, on which betelvine cultivation is to be done in first prepared by digging, breaking of clods, removing of stony parts, uprooting the unnecessary weeds, roots, etc, and leveling with the assistance of hand implements. The ground is made slightly slopy so as to check water logging which is harmful for betelvine cultivation.

In the hilly areas of Assam and Kerala and in some parts of Mysore, when betelvine is grown under relatively natural conditions as a mixed crop in aracanut or coconut plantation, no special selection or preparation of land is made, apart from what has been done for the main crop. In these areas, pits of various dimensions (60-120 cm. in diameter and 30-60 cm. in depth) are dug at the base of the supporting trees and they are filled up with top soil along with 0.5-2.0 kg of wood-ash. Drainage channels are prepared at every 2-3 rows of arecanut trees. In the plains, however, the land is ploughed or dug out and harrowed to obtain a fine tilth. Considerable, efforts are made to adopt a suitable layout, since betelvine is sensitive to soil and climatic conditions, and needs proper maintenance of moisture, soil aeration and sufficient humidity. Where betel vines are cultivated as a mixed crop in arecanut plantation, drainage channels are made between every two, three or four rows of the aeronaut tress depending upon the soil; in some areas lengthwise ditches are crossed by a number of cross drains also. In some place betelvines are grown on somewhat elevated beds, some times as high as 120 cm, alternating with strips of narrow trenches, where water is kept flowing or stored in pits.

Betelvine is a climber and needs support for its growth. In coconut and arecanut plantations, the support is provided by these trees, while in other areas support is provided by growing some quick growing straight stemmed plants like Sesbania grandiflora, S. sesban, Moringa oleifera, Erythrina variegata etc. Sometime bamboo, wooden or stone supports are used.
(b) Construction of Bareja

The structure of the betelvine gardens vary in different parts of the country. A bareja is usually of about half an acre (21, 780 sq.ft.). As mentioned earlier, the betelvine cultivation in Madhya Pradesh is done in a special kind of enclosed and roofed orchard near some source of water for creating near favorable conditions artificially for the growth of plants.

The betelvine crop is very sensitive to environmental conditions. For getting a good yield, therefore, certain arrangements are to be made. Such arrangement consists of raising of windbreak and provision of supports roofing for shade, and adequate facilities for irrigation and drainage. There are a large variety of lay-outs used for betelvine crop all over India, which are mainly due to differences of the soil, climate and availability of irrigation facilities. The construction of betelvine barejas, time and method of planting in other states of India are more or less same as Madhya Pradesh.

In Madhya Pradesh, the whole structure of betelvine garden is called Bareja or Bhit. Fencing of bareja is constructed by fixing in the ground eight feet tall bamboo poles 2.5-3.0 feet apart all around the plot. The space in between the bamboo poles are thatched with dry sun hemp stems, leaves of Sugarcane, Butea monosperma and/or other material up to a height of about 6-7 feet. This fencing is made so thick so as to prevent light and hot or cold winds to pass through. A passage of about 2-3 feet width is left all around the bareja on the inner side of the enclosure so as to serve the walking/working space. After wards the whole land is divided into ridges (beds) and furrows (walking space), which are about 15 cm. above the ground and 50 cm. wide respectively. Every furrow (walking space) is locally called "pari". After the beds are laid out the roof of the bareja is constructed. It is supported on additional bamboo poles fixed inside the bareja all along the walking space. The roof is the more densely thatched with dry grass leaves of Andropogon muricatus, Saccharcom spontaneum, etc. The thickness of the roof is suitably adjusted so as to allow only limited amount of sunlight and air to reach the growing plants. The barejas are erected in the month of February or March in certain places of Madhya Pradesh. In certain
other parts of the country a stone wall of the same height is erected instead of a bamboo fencing (Plate 3.1 a-d).

**Betelvine (Piper betle)**

Betelvine is an important medicinal plant and a cash crop of India. It has been referred to in the ancient Indian literatures dating back to 340 B.C. Betelvine is cultivated in hotter and humid regions of India in more than 50,000 hectare of land. With an approximate turnover of about 1,64,500 crores of rupees per year and providing livelihood to millions of families engaged in its cultivation and trade. It is used in most of the religious ceremonies and used for chewing by Indians for ages. In India and abroad betelvine is very popular amongst Hindus and Muslims. It is exported to several countries and thus is a valuable foreign exchange earner (Chaurasia, 2001).

The plant is commonly called as betelvine or Pan, which is cultivated at the altitude of about 900 meters. A perennial, dioecious, creeper, probably native of central and eastern Malaysia but believed to have come originally from Java. The cultivated Pan in India is usually the male plants selected from certain cultivars (varieties) and consequently does not fruit. Leaves are often 5-21 cm. long, simple, alternate, broadly ovate, slightly cordate and often unequal at the base, acuminate, acute, entire with often an undulate margin, smooth, glabrous, yellowish or bright green shining on both sides, membranaceous, or the adult ones coriaceous, petiolar is greenish, petiole stout, 2-5 cm. long, lamina ovate, heart shape with unicostate reticulate venation, base cardate, rounded or oblique (Plate 3.1b and d).

**Planting Season**

Planting seasons varies in the different tracts in the country. This is mainly due to differences in temperature and rainfall in these places; warm and moist weather favours good plantations. In plantation of coconut and arecanut or where dead supports are used, planting is done early in the season; where live supports are used, time is allowed for the latter to establish and develop sufficient shade and support for the vines. Based on
these considerations mainly, in Madhya Pradesh mostly planting is usually done only after winter i.e. in the month of March and April.

**Planting Material**

Cuttings taken from at least two years healthy vines propagate betelvine only vegetatively. These are obtained from vines of the previous year's growth. The top, usually with three to five nodes (30-45 cm. long sections) having a leaf at the central node, are used for planting. The sets are prepared from natural plants by breaking in such a way with hands that each cutting has a single node with one leaf (mother leaf) and a bud in its axial. In North India middle portion is used, the method of planting differs from region to region.

**Method of Propagation**

Terminal stem cutting propagate the vine or the sets are obtained from sufficiently mature plantations. One day before the plantation, the ridges are heavily irrigated so as to bring the soil moisture to full capacity. Two cutting are planted at each point alternately on the two sides of the ridges. The internode of each cutting is completely buried in the soil after digging small sloppy trench, while the leaf and the axillary bud are kept on the level of ground while planting, special care is taken to press the soil firmly around the cutting as this helps in making good contact with soil and to strike the roots. After planting the cuttings are covered with a very thin layer of moist grass, straw or such other material to provide additional moisture.

In some other parts of the country (i.e. Jabalpur, Madhya Pradesh) the cutting are first planted in nurseries and after the proper stage of growth they are transplanted in the garden. For this purpose, cuttings are planted close about 10 cm. apart in well prepared and shaded nurseries. In south India cuttings of the top portion of the vine are used for planting with 3-5 nodes in such a manner that 2-3 nodes are buried in the soil where as in North India middle portion is used.

**Irrigation and Water Management**

Irrigation depends upon intensity of light and relative humidity of the atmosphere. During summer season irrigation is given twice a day to betel
plants. During winter season irrigation is required once a day. In rainy season irrigation is done at weekly interval. In case of newly planted Bareja only sprinkler irrigation should be given twice a day with the help of earthen pot or rubber tubes. Normally bringing of water from nearby ponds is required for irrigation with the help of earthen pitches.

In some area, small pump and rubber pipes do irrigation. Tube-well water is the best for irrigation. Tank, pond or lake water may be used after disinfecting with commercial bleaching powder or some effective antibiotic or Neem powder. If water is used for irrigation by kachha pond and lake water without disinfecting there are good chances of infection, and crop may suffer from various diseases. If plant material or diseased leaves, foot and hand are washed by cultivators in khacha pond, tank or lake and if this water is used for irrigation than there is great possibility of disease because diseased part of leaves are also included in healthy leaves. In soil various plant pathogenic microorganism are also present and they are transmitted into the water. It is advised that all betelvine cultivators of the country and abroad should avoid the contaminating water of pond, tank and lake for irrigation. If the leaf washing is necessary in pond, tank and lake, the water should be disinfected after washing or before using it for irrigation.

Most of the betelvine cultivators of the country are using water for irrigation by pond. It is 15-50 feet deep and 10-60 feet wide which is prepared for the storage of water. This pond's water is not safe for betelvine crops because it contain various pathogenic microorganisms i.e. bacteria, fungi and nematodes. They are transmitted by soil to water and water to plants or in healthy soil by irrigation and causing various severe and devastating diseases i.e. foot rot and leaf rot of Pan caused by Phytophthora parasitica. If this fungal pathogen enters in garden, it may be transmitted very fast in the whole garden or in soil. The pathogen not only causes diseases but also survives in soil as chlamydospore, oospores and mycelium year after year. The cultivators may prefer to prepare ponds or tanks for water storage and to use disinfected water preferably tube-well water in
place of pond's water. This water should be replaced twice a month if necessary.

Cement tanks should be preferred in place of ponds, tube-well water may be use for irrigation purpose.

**Ratooning**

The vines become full grown in about 10 months, but the picking of leaves starts as early as 4 to 6 months after plantation. The picking of the leaves is done from the branches of the vine and not from the main stem. After a year when plant becomes old it begins to decay, a ratoon crop is than planted by coiling the vines and burying them again in the soil. These planted vines again sprout at the nodes and give new crop for another successive year. This ratooning is done year after 1-3 year in some orchards.

**Manuring**

This is an important aspect in betelvine cultivation, which is done after the betelvines are about a month old. In general, betelvine crop is given heavy doses of manures ranging from 25-100 tonnes per hectare in a year. Applying selected manure according to a worked out schedule continuously enriches soil in the root zone of the vine. This leads to increased production of pan and the leaves so produced are big and glistening. The manuring practices and the manure used vary considerably all over the country. Nitrogen 200 kg/ha per year in organic and inorganic forms is essential for better growth and leaf production. Nitrogen through inorganic source is much cost effective and as well helps in reducing many diseases. In addition, 100 kg K₂O/ha per year has been recommended. The fertilizers are to be applied in four split doses at 3-4 months interval. In some places, leaves of *Calotropis* spp. are used as manure, bio-fertilizers are also very useful (Neem or *Allium sativum*). In Madhya Pradesh, two types of manures; the dry powdered form and suspension form are used. Dry powdered form is prepared by mixing 500 kg oil cakes, 20 kg. castor oil or mustard oil and 72 kg grain flour for one hectare orchard. The suspension form is prepared by mixing 360 kg til oil cake (*Sesamum indicum*), linseed oil cake
PLATE 3.2: LEAVES OF P. betle

(a) Infected Leaf

(b) Infected Leaf

(c) Infected Leaf

(d) Healthy and Bifurcated Leaf
PLATE - 3.3: SPORANGIA, CHLAMYDOSPORES AND ENCYSTED ZOOSPORE OF P. parasitica var. piperina

(a) Cluster of sporangia

(b) Single sporangia with Sporangióphore

(c) Sporangia

(d) Empty and full sporangia

(e) Bipapillate Sporangia

(f) Encysted zoospores & Chlamydomspore
P. parasitica var. piperina

20 \mu m
P. parasitica var. piperina

20μm
(Linum usitatissimum) and barley flour for one hectare land. The mixture is allowed to ferment and left for a fortnight or so and then mixed in sufficient quantity of water. The dry powdered manure is applied at the foot of the betelvines during the rainy season, so as to reach the roots in solution. The suspension form of the manure usually is given in summer season. Occasionally the manuring is supplemented by other types of materials like neem cake, flours of various cereals etc. and when large quantities of such manures are not available they are supplemented or substituted by pond or river slit. Inorganic nitrogenous fertilizers are also being used.

Occurrence of Diseases and Symptoms

Leaf rot of pan is a common disease and a very serious problem in almost all the pan growing areas of India and other parts of the world. This disease appears only during the rains when both temperature and atmospheric humidity are highly and favourable and leaves are susceptible to this disease. It marks its appearance with the monsoon by the last week of June and first week of July. The losses caused by this disease are also considerable and range from 40-85 % in different barejas.

The first symptom of the disease is the development of a brown to black water soaked circular spot on the leaf which later turn deep brown to blackish, then it becomes soft and deliquescent in appearance under continuous humid conditions. The spot rapidly increases in diameter under moist conditions and extends to the major part of the leaf causing a soft rot. The rot may extend to the petiole and in some case it reaches to the stem also (Plate 3.2a-c).

On the lower side of the infected leaf in wet conditions a white cottony growth appears at the light coloured margins of the spots. This white growth is due to sporangia and sporangiophores of the fungus coming out through stomata or disintegrated lower epidermis. If wet conditions are not continuous and if rain lasts only for a day or two with intervening dry warm periods the diseased areas develop concentric zones of development due to alternate favorable and unfavorable periods of growth. Under dry conditions the progress of the disease is checked totally and the spots become irregular
with shrunken and brown in surface. One or more than one spots may be found on a leaf and the leaf at any position in the plant may be attacked but those within 2 to 3 feet of the ground level are more commonly affected than others leaves, which are presented at greater heights.

Foot rot of Pan is very serious disease occurring in almost all the betelvine growing parts of India and the world. The first visible symptom of the disease is the disappearance of luster of the leaves. Soon after the plant begins to show sign of wilting. The leaves droop down and become pale green. Finally the vine is completely wilted and dries up. The under ground parts which are the activity centre of the pathogen are almost completely rotted. The damage done to the crop by foot rot may vary from 40-100%.

Disease Cycle

The pathogenicity of *Phytophthora parasitica* to the pan crop was well established (Dastur, 1935; Mahmud, 1940; Chaursia, 1976; Vyasa and Chaursia, 1976; Chaursia, 1994, 2001). Mahmud (1940) claimed the isolation of the pathogen from the soil and concluded that the fungus live saprophytically in the soil and can survive for years. Mehrotra and Tiwari (1967) repeatedly tried to isolate pathogen by Meredith's method (Meredith, 1940) but got negative results. They however, succeeded in isolating *Phytophthora* from the soil by the method adopted by Occana and Tsao (1966). Mehrotra and Tiwari (1967) measured the competitive saprophytic ability of *Phytophthora parasitica* var. *piperina* by Wastie's method (Wasties, 1961). The results of these experiments revealed that betelvine *Phytophthora* is a poor saprophytic competitor and is easily suppressed by other soil organisms.

Mehrotra and Tiwari (1967) studied the survival of *Phytophthora* as mycelium in host tissue and pathogen could be isolated up to 17 weeks from the host tissues. Chowdhary (1944) and Asthana and Mahmud (1945) found that the disease is primarily carried through the plantation.
Pathogen

*Phytophthora parasitica* var. *piperina* Dastur is responsible for foot rot and leaf rot of pan (*Piper betle*). According to Dastur (1935) this fungus has generally intercellular hyphae, some time intracellular hyphae, some time intracellular, haustoria absent. Sporangia are produced on sporangiophores, which differ slightly from vegetative hyphae. Sporangia are born terminally but are subsequently shifted to a lateral position sporangiophores are sympodially branched sporangia pear shaped or broadly ovate with a prominent papilla, measuring 30-63.3 X 20.4-40.8μm, motile zoospore bean-shaped and biflagellate, encysted zoospores, spherical, measuring 2.2-5.7 μm, in diameter; chlamydospores are at first hyaline, smooth, thin-walled and spheroidal, after fertilization thick and smooth or rough walled, yellow or yellow brown in colour, measuring 20.4-40.8 μm; antheridia hyaline, thick walled, persistent, and amphigynous, one antheridium per oogonium oospores sphieical, almost filling the oogonium, smooth and thick walled, hyaline or very pale yellow coloured, measuring 17.8-53.1μm (Plate 3.3 a-f).

Sporangia develop only at 20-31°C when relative humidity is about 80-100%. Water is essential for the liberation and movement of zoospores, which is maximum at 21-23°C. The work of Mehrotra (1961), Tiwari (1968) and Saxena and Mehrotra (1970) clearly showed that the infected parts rot rapidly and that the mycelium cannot be detected outside in the form of lesions except at the incipient stage of infection. This possibility however, should be kept in mind and probably is responsible for the post observation by Chaurasia (1976) and Chaurasia (1994) that the cutting planted, from a badly infected orchard carry the disease in most cases. Besides chlamydospores, Vyas and Chaurasia (1976) have detected oospores of the pathogen in nature. Turner (1969) had earlier reported the formation of sex organs and oospores by Sarawak isolate of *Phytophthora* from *Piper betle* and *Piper longum*. Thus the pathogen is capable of surviving in soil in the form of oospores and chlamydospores.