CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction
The review of literature to betelvine was important and useful for research task. Review of literature focused on the past research work done so far. It enlightened the researcher to identify various aspects and views in regard to betelvine cultivation.

M. L. Nayak, the organizer, National symposium on betelvine production technology (1993) reported that no published literatures on betelvine cultivation were available. They were organized a national symposium to collect the information on various aspects of betelvine cultivation in India, it was useful to the research workers, students, elite cultivators and staff of agriculture department.

2.2 Identification of Betelvine Leaves
Betel or Pan (Piper Betel Linn.) used as a chewing material in almost all Asian countries. The genetic name piper was probably derived from Sanskrit word Papilla for pepper. The word betel came from the Malayalam word Betrca (Gowda 1951).

In India, betelvine was known in different names in different languages. In Sanskrit it was called as Nagavali, Tamulum etc. In Hindi, Bengali, Marathi and Gujarati it was called as Pan, in Telugu as Tamalapaku, Kill, Nagavati etc. In Kannada it was called as Viledyali in Malayalam it was named as Vetillai.
Pan was used in all Hindu religious and cultural celebrations. It was also used after lunch and dinner and many other social gatherings. There were many references for betel leaves which were found in the early Sanskrit literature (3000 B.C.) like Vedas and the epics like Ramayana and Mahabharata. In Aryan culture, Pan was used by their women for colouring their lips and flavoring their breath. Earlier travelers like Herodotus and Megasthens explained the significance of Pan in their travelogues. Marcopolo (1295) mentioned in his book the habit of the people of South India and described the Pan preparation. In Mogal court, the habit of pan chewing became much popular.

2.3 Cultivation of Betelvine Leaves

In the world, India, Bangladesh and Sri Lanka were the major countries to cultivate betelvine leaves. Malaysia, Singapore, Thailand, Philippines etc. were also noted for the cultivation of betelvine leaves. In Pakistan, large scale production of betelvine leaves was not possible and therefore Pakistan imported from Bangladesh, Sri Lanka, India and Thailand about 5000 tonnes of betel leaves worth of Rs. 20 crores (Doosani 1989).

The cultivation of betelvine leaves in Sri Lanka had a history of 2000 years. It was cultivated in the western region of Jafana, Kegaile and Gampha. Sri Lanka exported to Pakistan worth of 3000 tonnes per year. In India, approximately 50000 hectares were under cultivation. The crop was grown on commercial basis in Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal, Kerala, Assam, Bihar, Uttar Pradesh, Madhya Pradesh, Orissa and Tripura.
2.4 Propagation

Gosh and Deshpande (1984) observed that dipping the cuttings in 100 mm IBA solution for 12 hours before planting promoted formation of the maximum number of roots.

Mahmud (1950) observed that the top three cuttings from the upper part of vine recorded a high rate of growth as well as gave higher yield than other cuttings. Cuttings from the base portion of vine with 5-12 nodes each, took a long period to root. The rooting was poor and the mortality was high due to Phytophthora infection.

Yajna Narayan Aiyer and other, Indian Fmg. N. S., (1966-67), reported that the plantations of betelvine cuttings took from healthy vines at least two years old. Each cutting contained 3 to 5 nodes and was planted in such a manner that two nodes were buried in the soil and two or more nodes were above the ground. In some places, growers raised a nursery of root cuttings and then transferred them to their permanent places.

2.5 Spacing

Balsubrammanyam (1984) observed that a wide ranging with systematic spacing for Desawari vines, inter-row spacing of 30 x 30 cm. gave the maximum yield of leaves with better quality. The number of seed plants used varied considerably, depending upon the type of lay-out, spacing length of cuttings, supports etc.

2.6 Effect of Spacing and Plant Population on Growth and Yield

In the annual report of all India Co-ordinated Research project on Betelvine (2000-01) was given the result of spacing and
Table 2.1

Effect of Spacing on Growth and Yield

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Plant Population / (ha.)</th>
<th>Height of Vine</th>
<th>No. of Branches per Vine</th>
<th>No. of Leaves Per ha. (Lakhs)</th>
<th>Weight of 100 Leaves (gm.)</th>
<th>Keeping Quality (Days)</th>
<th>% PDI (Foot rot)</th>
<th>Average leaf size (cm.)</th>
<th>Average Shoots Per ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25,000</td>
<td>4.86</td>
<td>29.8</td>
<td>81.7</td>
<td>250</td>
<td>11.6</td>
<td>21.12</td>
<td>16.0 x 10</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>50,000</td>
<td>3.59</td>
<td>22.8</td>
<td>81.3</td>
<td>209</td>
<td>12.4</td>
<td>15.9</td>
<td>15.0 x 9.5</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>75,000</td>
<td>3.11</td>
<td>13.8</td>
<td>72.2</td>
<td>225</td>
<td>11.2</td>
<td>36.9</td>
<td>13.5 x 8</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>1,00,000</td>
<td>2.94</td>
<td>11.4</td>
<td>70.1</td>
<td>200</td>
<td>12.2</td>
<td>35.3</td>
<td>10 x 7</td>
<td>4</td>
</tr>
<tr>
<td>SE ±</td>
<td>0.09</td>
<td>0.82</td>
<td>1.21</td>
<td>6.98</td>
<td>0.31</td>
<td>1.07</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>0.25</td>
<td>2.47</td>
<td>3.84</td>
<td>20.95</td>
<td>NS</td>
<td>4.0</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>CV %</td>
<td>13.72</td>
<td>6.50</td>
<td>7.24</td>
<td>14.60</td>
<td>10.2</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

The data presented in table 2.1 revealed that maximum revealed vine height, number of branches (29.8 per plant) and leaf yield (8.17 lakhs per hectare) was recorded in 25,000 plants population per hectare followed by 50,000 per hectar. In case of 25,000 plant population per hectare recorded highest weight of 100 leaves (250 gm.) The keeping quality of leaves was non significant. The disease percentage was lowest in 50,000 plant population per hectare and 25,000 plant populations per hectare.

2.7 Soil for Betelvine Cultivation

Irhayaraj, Madras Agriculture Journal (1960) 47,463; Yegna Narayan Aiyer, 521; Chowdhury, Indian Fmg, (1944) 5,122 reported the soil for betelvine cultivation was red loams which was friable, rich in organic matter, which had good drainage and with good depth were also favored where the soil was coarse or stony, the area filled with suitable soil before planting.

Waghe (1991) suggested that after lowering of betelvine, it required support by Sandy 10 gm to the betelvine coil
which helped to prevent diseases and gave better quality and higher production.

2.8 Irrigation and Drainage

Balsubrammanyam and Chaurasia (1962) studied the comparative cost and efficiency of sprinkler system; wind mill system photovoltaic pump and low power portable pump set for irrigation to betelvine. If the Government subsidy was available, the establishment of wind mill system and photovoltaic pump costs Rs. 11,500 and Rs. 8,500 respectively was possible. In these two cases recurring cost of irrigation was almost negligible. In case of sprinkler system the cost of installation worked out Rs. 30,000/- per hectare. In case of low power pump set, the capital cost was Rs. 5,000/- if the Government subsidy was available, the running cost was estimated at Rs. 240 per hectare for irrigation.

B. Dasgupta and others (1993) reported that the soil in the betelvine garden was constantly kept in moist to avoid water stagnation. Further they added that during rainy season, no water was supplied. In the winter season very light water was supplied at an interval of 10-25 days. During summer, water was supplied according to the needs. In West Bengal, water was supplied by small pump and rubber pipes.

2.9 Drip Irrigation

S. V. Waghe and others (1993) had undertaken field trial on drip irrigation and its effects on will incidence drip irrigation system for betelvine cultivation helped to save 70 percent to 80 percent water as compared with traditional bed irrigation (Shinde 1982).
Their experiment revealed that the betel vine wilt was minimized to zero percent under drip irrigation but 20-80 percent and 18.60 percent within was observed during 1987-88 and 1988-89 respectively in channel irrigation.

They also reported that during summer, the rate of shoot growth in six and seven liters water supply per day was more as compared with four and five liters water supply.

They further observed the size of the betel leaves was increased according to the increase in the rate of water discharged through the drip irrigation system.

Again, they revealed that the weight of hundred leaves in five liters water discharged was higher (433.70 and 427.09 gm.) followed by six liters of water supply (403.70 and 423.09 gm.) per day. In case of channel irrigation (control treatment) weight of hundred leaves was less (194.50 and 189.90 gm.) during 1987-88 and 1988-89 respectively.

In short, they observed that the drip irrigation of five six and seven liters water per day gave higher shoot growth, better leaf size, higher weight of hundred betel leaves and least wilting percentage in Bangla variety in Akola region of Maharashtra.

In the annual report of All India Co-ordinated Research Project on Betelvine (2000-01) was given the results of application of drip irrigation on yield parameters at Mahatma Phule Agriculture University at Sangli center.
Table 2.2
Effect of drip Irrigation on Yield Parameters at MPAU at Sangli Center

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Irrigation Treatment</th>
<th>High of Vine (M)</th>
<th>No. of Branches / vine</th>
<th>Leaf yield Lakhs / ha</th>
<th>Fresh Weight of 100 leaves</th>
<th>Keeping quality &amp; days</th>
<th>Water Saving</th>
<th>% PDI (foot and rot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50% Evaporation replenishment</td>
<td>2.15</td>
<td>10.00</td>
<td>11.29</td>
<td>143.75</td>
<td>10.7</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>75% Evaporation replenishment</td>
<td>2.46</td>
<td>13.25</td>
<td>12.12</td>
<td>157.70</td>
<td>10.5</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>3</td>
<td>100% Evaporation replenishment</td>
<td>3.41</td>
<td>20.25</td>
<td>27.89</td>
<td>224.00</td>
<td>13.2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>4</td>
<td>125% Evaporation replenishment</td>
<td>4.38</td>
<td>26.75</td>
<td>32.09</td>
<td>234.70</td>
<td>13.7</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>5</td>
<td>150% Evaporation replenishment</td>
<td>4.02</td>
<td>22.50</td>
<td>29.65</td>
<td>234.50</td>
<td>13.00</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>6</td>
<td>Surface irrigation</td>
<td>3.42</td>
<td>17.5</td>
<td>23.75</td>
<td>225.00</td>
<td>14.2</td>
<td>NA</td>
<td>38.27</td>
</tr>
<tr>
<td></td>
<td>S. Em. +</td>
<td>0.089</td>
<td>0.84</td>
<td>0.60</td>
<td>2.43</td>
<td>0.37</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>CD (P = 0.05)</td>
<td>0.26</td>
<td>2.54</td>
<td>1.80</td>
<td>7.31</td>
<td>1.12</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>CV (%)</td>
<td>12.42</td>
<td>9.10</td>
<td>7.86</td>
<td>11.30</td>
<td>12.40</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Data presented in the Table 2.3 showed that the application of water at 125 per cent evaporation replenishment through drip irrigation produced significantly maximum vine height (4.38 m), number of branches per vine (26.75) and number of leaves per hectare (32.09 lakhs). Fresh leaves weight of 100 leaves was 234.70 gm.

The incidence of disease viz. foot rot was observed in surface irrigation treatment incidence of foot rot was 38.27 per cent while in drip irrigation foot rot was not observed.

It also reported that among all irrigation treatment, significantly higher yield was observed under drip irrigation with 125 per cent evaporation replenishment rate was followed by 150 per cent evaporation replenishment and 100 percent evaporation replenishment rates respectively. Lowest yield was observed at 50
per cent evaporation replenishment treatment followed by 75 percent. The yield of these two treatments was less than even surface irrigation treatment. There was 32.60 percent to 66.80 percent saving of water under drip irrigation method as compared to surface irrigation method.

S. Maiti and K. S. Shivashankara (1981-1997) reported the results of drip irrigation on growth and leaf yield in the Betelvine Research Highlights. They suggested the application of drip irrigation to replenishment 100 percent and 150 percent of evaporation demand at Jawaharlal Nehru Krishi Vishwa Vidyalaya at Jabalpur and Mahatma Phule Agricultural University respectively gave maximum and significantly higher leaf yield and higher vine growth.

S. M. Patil (1990) suggested the following drip irrigation system for betelvine cultivation.

Table 2.3

Month-wise Daily Water Requirement for Betelvine

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Month</th>
<th>Daily Water (Liters)</th>
<th>Drip Period (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>January</td>
<td>8</td>
<td>2.20</td>
</tr>
<tr>
<td>2</td>
<td>February</td>
<td>9</td>
<td>2.40</td>
</tr>
<tr>
<td>3</td>
<td>March</td>
<td>10</td>
<td>2.40</td>
</tr>
<tr>
<td>4</td>
<td>April</td>
<td>11</td>
<td>3.10</td>
</tr>
<tr>
<td>5</td>
<td>May</td>
<td>12</td>
<td>3.25</td>
</tr>
<tr>
<td>6</td>
<td>June</td>
<td>10</td>
<td>2.40</td>
</tr>
<tr>
<td>7</td>
<td>July</td>
<td>06</td>
<td>1.50</td>
</tr>
<tr>
<td>8</td>
<td>August</td>
<td>06</td>
<td>1.50</td>
</tr>
<tr>
<td>9</td>
<td>September</td>
<td>07</td>
<td>2.00</td>
</tr>
<tr>
<td>10</td>
<td>October</td>
<td>08</td>
<td>2.20</td>
</tr>
<tr>
<td>11</td>
<td>November</td>
<td>07</td>
<td>2.00</td>
</tr>
<tr>
<td>12</td>
<td>December</td>
<td>07</td>
<td>2.00</td>
</tr>
</tbody>
</table>
50 to 60 percent water saving were possible by applied of drip irrigation system. It also helped to increase by 30 to 40 percent in yield of betel leaves. It improved quality of leaves and protected the vine from foot rot disease.

2.10 Planting Treatment of seed Plants

Johri (1991) explained that for protection of seed plants and vine from plant-born fungal and bacterial diseases, the selected seed plants were to be dipped for 30 minutes before planting in a solution of 0.5 % Bordeaux mixture and 500 ppm streptocucline.

2.11 Medicinal Value

Vidyaratnam P. S. (1995) pointed that the betelvine leaves were useful for bronchitis, asthma, catarrh, cough, leprosy, alcoholism, syncope, otalgia, fever halitosis, impotency, rheumatism, dyspepsia, and phavyngopathy, vitiated conditions of kapha, colic, diarrhea and laryngitis.

Gowda Bot. Mus. Leaf Harv. (1951), 14 (8) reported that, Central Food Technological Research Institute, Mysore was developed Pan Supari and was said to be a good source for calcium.

Mann and Patwardhan, loc. cit; Indian Fmg. N S.; (1957-58), 7(10) their analysis of samples of fresh and bleached leaves from Pune showed and bleached leaves proportion of non-reducing sugar 1.30 – 2.29; reducing sugar 0.43-0.83; starch 3.10-1.44; tannin acid 2.05-1.89 and essential oil 1.23-4.20 percentage respectively. The betel leaves containing a fair amount of vitamins B, ascorbic, carotene and all other essential acids.

The analysis of sample fresh leaves gave the following values moisture 85.4 %, protein-3.10 % fat-0.80%; carbohydrates
Ghani and Sial, loc. cit; Dutt Indian sop I; (1955-56) 21, 275; Guenther v. 160; Aann and others reported that the essential oil contained and varied from 0.7 % to 2.6 %. The yield of oil depended upon the time of plucking, leaf position on the vine, nature of leaves-fresh of dry, bleached of unbleached and leaves from the upper parts of the vine containing more essential oil than those from the lower parts. Oil extracted from matured leaves was high as compared to over-ripe leaves.

M. L. Sharma (1993) analysed the oil contents in matured leaves (three month old). The yield and consistency of the oil in fresh weight basis of leaves was given as follows.

Table 2.4

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Type</th>
<th>Consistency of the Oil</th>
<th>Yield of the Oil in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Deshi Bangla</td>
<td>Heavier than water</td>
<td>0.11</td>
</tr>
<tr>
<td>2</td>
<td>Ramtak</td>
<td>-//-</td>
<td>0.12</td>
</tr>
<tr>
<td>3</td>
<td>Nawa Kala Patta</td>
<td>-//-</td>
<td>0.12</td>
</tr>
<tr>
<td>4</td>
<td>Desawari Mahoda</td>
<td>-//-</td>
<td>0.13</td>
</tr>
<tr>
<td>5</td>
<td>Desawari Desi</td>
<td>-//-</td>
<td>0.14</td>
</tr>
<tr>
<td>6</td>
<td>Sanchi</td>
<td>-//-</td>
<td>0.11</td>
</tr>
<tr>
<td>7</td>
<td>Kera</td>
<td>-//-</td>
<td>0.13</td>
</tr>
<tr>
<td>8</td>
<td>Kajedu</td>
<td>-//-</td>
<td>0.14</td>
</tr>
<tr>
<td>9</td>
<td>Kaker Satna</td>
<td>-//-</td>
<td>0.11</td>
</tr>
<tr>
<td>10</td>
<td>Meetha</td>
<td>-//-</td>
<td>0.15</td>
</tr>
<tr>
<td>11</td>
<td>Kapoori</td>
<td>Lighter than water</td>
<td>0.10</td>
</tr>
<tr>
<td>12</td>
<td>Green</td>
<td>-//-</td>
<td>0.18</td>
</tr>
<tr>
<td>13</td>
<td>Kapoori Bihar</td>
<td>-//-</td>
<td>0.10</td>
</tr>
</tbody>
</table>
2.13 Classification of Betelvine Variety

There were about hundred varieties of betel leaves reported by the growers and traders. These were classified on the basis of shape, size, texture and test of leaves. The same variety was cultivated under different names in different areas. Satyabrata Maity and Kajal Sengupta reported the important varieties cultivate in different states in India.

Table 2.5

State-wise Classification of Betelvine Variety

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>States</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andhra Pradesh</td>
<td>Karapaku, Chennor, Tellaka, Bangla</td>
</tr>
<tr>
<td>2</td>
<td>Assam</td>
<td>Khasi, Assamiya, Bangla, Awani, Garo, Karbi, Nagu</td>
</tr>
<tr>
<td>3</td>
<td>Bihar</td>
<td>Deshi, Calcutta, Bangla, Maghai, Kapoori</td>
</tr>
<tr>
<td>4</td>
<td>Karnataka</td>
<td>Kariuale, Mysoreate, Ambadiale/Ambadi Badami</td>
</tr>
<tr>
<td>5</td>
<td>Kerala</td>
<td>Nanda/Nandan, Kalkodi, Puthukodi, Thulas, Venmani</td>
</tr>
<tr>
<td>6</td>
<td>Madhya Pradesh</td>
<td>Desawari, Deshi, Bangla, Calcutta, Bangla</td>
</tr>
<tr>
<td>7</td>
<td>Maharashtra</td>
<td>Kapoori, Kalipatti, Ramtak, Bangla</td>
</tr>
<tr>
<td>8</td>
<td>Orissa</td>
<td>Godi, Bangla, Nana Bangla, Deshi Pan (Kapoori),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alupatria, Jaganathi</td>
</tr>
<tr>
<td>9</td>
<td>Tamil Nadu</td>
<td>Pachaikodi, Vellakodi, Kapoori</td>
</tr>
<tr>
<td>10</td>
<td>Uttar Pradesh</td>
<td>Desawari, Kapoori, Meghai, Mahoba Bangla</td>
</tr>
<tr>
<td>11</td>
<td>West Bengal</td>
<td>Mitha Sahchi, Deshi Bangla, Kali Bangla, Ghanagete</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bangla, Birkuli</td>
</tr>
</tbody>
</table>

Ganguly and Gupta (1978, 1974) reported that in the West Bengal, three varieties were generally cultivated namely Sahchi, Meetha and Bangla.

Rawant and Balsubrahmmanyam (1988) classified the varieties in six types based on leaf morphology and chemical composition of essential oil of the leaves. These varieties were Bangla, Deshwar, Kapoori, Mettha, Sanchi and Khasi.
Marti and Biswas (1991) reported morphological differences mainly due to sexual dimorphism in leaf shape that existed in betelvine. Male plants had leaves which were narrowly ovate with $1.84 \pm 0.21$ length and breadth value and female plants had cordite ovate to leaves with $1.26 \pm 0.13$ length and breadth value.

R. L. Sharma (1993) classified various varieties of betelvine into main six groups. These were given as follows.

**Table 2.6**

**Grouping of Various Betelvine Varieties**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Type</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Desi Bangle</td>
<td>Bangla</td>
</tr>
<tr>
<td>2</td>
<td>Ramtak</td>
<td>-/-</td>
</tr>
<tr>
<td>3</td>
<td>Nava Kale Patta</td>
<td>-/-</td>
</tr>
<tr>
<td>4</td>
<td>Green</td>
<td>Kapoori</td>
</tr>
<tr>
<td>5</td>
<td>Kapoori</td>
<td>-/-</td>
</tr>
<tr>
<td>6</td>
<td>Kapoori Bihar</td>
<td>-/-</td>
</tr>
<tr>
<td>7</td>
<td>Mahoba Desawari</td>
<td>Desawari</td>
</tr>
<tr>
<td>8</td>
<td>Desi Desawari</td>
<td>-/-</td>
</tr>
<tr>
<td>9</td>
<td>Sanchi</td>
<td>Sanchi</td>
</tr>
<tr>
<td>10</td>
<td>Kuljedu</td>
<td>-/-</td>
</tr>
<tr>
<td>11</td>
<td>Kera</td>
<td>-/-</td>
</tr>
<tr>
<td>12</td>
<td>Kaker Satna</td>
<td>-/-</td>
</tr>
<tr>
<td>13</td>
<td>Meetha</td>
<td>Meetha</td>
</tr>
</tbody>
</table>
2.14 Plantation Seasons

Chaugule, loc. cit; (Bull. Department of Agricultural No. 146, 1926, 93; Rao and Madharachari, loc. cit;) They reported that planting of betelvine in Kerala, Karnataka and in Assam started immediately after onset of monsoon in May-June. In Madras, planting was done in June-July. In Maharashtra, Andhara Pradesh planting was delayed upto August-September.

2.15 Inter-Cropping

Yajna Naryan Aiyer, (1955-56) 527 reported that in India along with betelvine other crops were grown as intercrops. In Maharashtra, Madra, Karnataka, Andhra Pradesh and Western Madhya Pradesh, banana suckers were plashed in betelvine gardens. Plants of banana trees were useful for obtaining the fiber to tie the betelvines. The banana leaves and fiber was used as packing material. In Uttar Pradesh yam and other vegetables were planted in betelvine garden as inter crops. In West Bengal bottle gourds and pumpkins were grown around the betelvine gardens to provide additional shelter and as a source of subsidiary income.

2.16 Plasticulture In Betelvine Cultivation

Chandra, Pitam (1990) studied the three methods of growing betelvine in India. In the first method betelvine was grown with mixed plantation such as arc nut, jack fruit, mango and coconut where no further shade was required. In the second method, betelvine was grown together with fast growing plants such as Shevari (Sesbania aegyptiaca Poir), Pangara (Erythrina indica Lam.), Drumstick (Moringa Oieifera Lam.) and Bakan (Melia Azedarach Linn) were planted. In the third method, artificial
shades were created which known as Boroj or Bareja. Under this method betelvine was grown under plastic green house.

Cultivation of betelvine in shade net experimented at All India Co-ordinated Research Project on Betelvine at Sangli in Maharashtra and at Jabalpur of Madhya Pradesh. It was experimented that growth of betelvine was vigorous upto 4 - 4.5 meters within five to six months. It became compulsory to tower betelvine at two times in a year. There were no more branches and sub-betelvine leaves production.

2.17 Fertilizations

P. V. Nakat (1995) reported in his unpublished Ph.D. theses Ecobiology and Management of Red Vegetable Mite, *Tertanyxchus neocaledancius Andre* on Betelvine submitted to Mahatma Phule Agricultural University, Rahuri. He stated that increase in doses of nitrogen to the betelvine plant significantly increased the mite of infestation. It was also observed that the population of red vegetable mite in different treatments showed increasing trend of population in every week of observation till seventh week but after three weeks it declined at faster rate till the end of the experiment.

In a survey carried out by Balsubramanyam (1984-89) in Uttar Pradesh and some parts of Madhya Pradesh. It was observed that one in every three respondents followed the practice of using fertilizers for the betelvine for the better quality leaves.

A. Narain (1983) observed in Orissa that oil-cakes of mustared, Til-neem and Karanji (Pongamia Pinnata) were used and fertilizers like urea and ammonium sulphate were rarely used. The oil-cake was decomposed with fresh cow-dung slurry for two
weeks and then applied to betelvine. Near about 2-15 tonnes of oil-cake per hectare/year were used.

Madhane and Narkhade (1983) reported that heavy manure was used at frequent intervals in Bassein area of Maharashtra where castor-cake was the main source of organic manure. In Western Maharashtra farm-yard-manure 12-15 tones at lowering of betelvines and 30-35 tonnes per hectare during July-August was generally applied.

Shanmugam (1983) observed in Tamil Nadu that manures were not applied before planting. After two months of planting 50 tonnes per hectare of farm-yard-manures was applied. 300 Kg per hectare a groundnut cake each time for six times at an interval of 1.5-2 months was also applied. Farmers applied fertilizers like 17:17:17 or diammonium phosphate 16:20:0 (NPK) at 250 Kg per hectare along with 300 Kg groundnut cake at an interval of 4, 6 and 9 months after planting. Green manure at 5-10 tonnes per hectare was also applied by farmers.

In Andhra Pradesh, Papa Rao (1983) reported that in addition to farm yard manure 50 tonnes per hectare, groundnut cake was applied after planting and subsequently fertilizers, such as urea, CAN at 200 Kg. Per hectare were applied once in two months interval and at lowering farmyard manure was repeated.

Amzad Hussain (1986) suggested that there was no standard recommended schedule for fertilizers application in Bangla Desh. Application of oil cake as a manure alone varied from 1.25 to 9 tonnes per hectare in Bangla Desh.
2.17.1 Effects of Fertilizers (Nitrogen) on Betelvine

Das J. N. and others (1989) reported the effect of nitrogen on yield and incidence of diseases on betelvine in Orissa. Application of urea alone or with mustard oil cake for betelvine increased bacterial leaf spot anthracnose and vine rot. The addition of mustared and neem cakes resulted in significant reduction in the diseases.

Das J. N., and others (1990) reported the effect of potash on leaf yield and disease incidence on betelvine leaves in Orissa. Application of P₂O₅ at 125 Kg. per hectare annually gave the maximum height of betelvine and maximum leaf yield with the lowest incidence bacterial leaf spot anthracnose and vine rot.

2.17.2 Results of Fertilizer Experimentations

Sarkar and others (1984) in West Bengal observed that 8.4 tonnes per hectare of mustered cake alone or mustered cake in combination with calcium ammonium nitrate (1:1) 210 Kg nitrogen per hectare gave the maximum response in terms of yield of Bangla leaves.

Pradhan and Das (1984) concluded that the disease incidence was more at 105 Kg nitrogen per hectare per month during rainy season (total 420 Kg nitrogen per hectare). They also observed that vines fertilized with urea suffered loss due to disease then those vines treated with calcium ammonium nitrates.

Mishra and others (1984) also recommended calcium nitrate application at 420 Kg. Nitrogen per hectare for better growth and yield of betelvine leaves.

Gosh and others reported their experience that steramel or calcium ammonium nitrate to mustered cake at 420 Kg nitrogen per hectare was useful for better yield of betelvine leaves.
Debnath and others observed that C. V. Bangla variety application resulted better by applying 240 Kg Nitrogen through mustered cake 240 Kg P$_2$O$_5$ as super phosphate and 240 Kg P$_2$O$_5$ as murinate of potash per hectare which gave much quality of betel leaves. Under this treatment betel vines were comparatively free from diseases and the benefit cost ratio was 5:1.

Narayan Reddy (1984) suggested that 682.5 Kg nitrogen as groundnut cake and 56.9 Kg P$_2$O$_5$ as super phosphate and 56.9 Kg. P$_2$O$_5$ a muriate of potash with basal dressing of 50 tonnes of compost per hectare for better yield of betel leaves in Andhra Pradesh.

Pawar (1987) in Maharashtra observed that application of 200 Kg nitrogen 50 Kg P$_2$O$_5$ as super phosphate and 50 Kg. P$_2$O$_5$ as muriate of potassium per hectare gave maximum yield of kapoori leaves.

Samiappan and others (1984) observed in Tamil Nadu that maturing formed the major item in the working expenses.

Balsubrammanyam and others (1991) carried out a trial that critical factor of the nutrient elements for maximum response of yield was observed by applying 188 Kg. nitrogen 155 Kg. potash, 105 Kg k, 17 Kg. mg and 20 Kg Zn per hectare. These, subsequent, trials, showed that neem cake at 150 Kg nitrogen per hectare in appropriate split doses were sufficient to get optimal yield of betel leaves.

### 2.17.3 Vines Response to Nitrogen

In Maharashtra, maximum yield of marketable leaves was obtained when the vine was treated with 200 Kg nitrogen per hectare through neem cake, Annual Report 1991 if All India Coordinated Research Project on Betelvine. In general, the
maximum response was obtained within nitrogen applied at 150-200 Kg per hectare.

2.17.4 Vines Response to Phosphorus

Nayak and others (1984) reported that betelvine response to phosphorous was positive and those high does of 250 Kg. P$_2$O$_5$ per hectare increased the yield of leaves and reduce the mortality of vines caused by foot rot. In Maharashtra 100 Kg. P$_2$O$_5$ per hectare significantly increased the yield of betel leaves. (Anon, 1991)

2.17.5 Vines Responses to Potassium

Co-ordinated trial of vines response to potassium on the yield and quality of betel leaves was carried out in Agricultural Universities of different states (Annon, 1990). In these trials a fixed dose of 150 Kg nitrogen and 100 Kg potassium through oil cake and super phosphate respectively were given. The results in Andhra Pradesh, West Bengal, Maharashtra etc. showed that 100 kg per hectare increased the yield and quality of betel leaves. Loss due to disease was less under the treatment.

Mishra and others (1991) observed in Uttar Pradesh that application of potassium at 100 kg per hectare was sufficient to get the maximum yield of acceptable quality.

Mishra and others (1991) observed that application of potassium at 100 kg per hectare was felt to be increased with oil contents and it was felt essential to improve quality of leaves. Under these treatments betel leaves remained fresh when stored upto 30 days. The spoilage at the end of one month was 25 percent.
Pawar (1987) in Maharashtra suggested that application of potassium at 125 kg. P2O5 per hectare improved the quality by application of fertilizers and diseases were wiped out.

2.17.6 Effect of Bio-fertilizers On Growth and Yield of Betelvine Leaves

In the annual report of All India Co-oriented Research Project on Betelvine reported the effect of bio-fertilizer on growth and yield of betelvine leaves.

**Table 2.7**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment</th>
<th>Height of Vine (m)</th>
<th>No. of branches per vine</th>
<th>No. of leaves /ha. (lakhs)</th>
<th>Weight of 100 leaves (gm)</th>
<th>Keeping quality (days)</th>
<th>% P02 (foot rot)</th>
<th>Cost benefit ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A20, 5Kg+100 kg. pt 100 Kg K/ha</td>
<td>3.31</td>
<td>16.5</td>
<td>56.63</td>
<td>223.7</td>
<td>10.5</td>
<td>17.40 (24.68)</td>
<td>1:3.35</td>
</tr>
<tr>
<td>2</td>
<td>Pho 5Kg + 200 Kg. N+ 100 Kg K/ha</td>
<td>3.46</td>
<td>18.7</td>
<td>59.4</td>
<td>218.7</td>
<td>10.5</td>
<td>22.32 (28.15)</td>
<td>1:3.49</td>
</tr>
<tr>
<td>3</td>
<td>A2o 5Kg + Pho. 5Kg. + 100 Kg K/ha</td>
<td>4.15</td>
<td>25.0</td>
<td>70.22</td>
<td>238.2</td>
<td>15.72</td>
<td>15.72 (23.28)</td>
<td>1:4.20</td>
</tr>
<tr>
<td>4</td>
<td>200 Kg N + 100 Kg P+100 Kg K Kg K/ha</td>
<td>3.86</td>
<td>17.3</td>
<td>63.05</td>
<td>182.5</td>
<td>9.20</td>
<td>33.0 (36.01)</td>
<td>1:3.67</td>
</tr>
<tr>
<td>5</td>
<td>200 Kg N + 100 Kg P+100 Kg K Kg K/ha</td>
<td>3.20</td>
<td>15.5</td>
<td>59.79</td>
<td>198.5</td>
<td>9.00</td>
<td>36.30 (36.95)</td>
<td>1:3.19</td>
</tr>
<tr>
<td></td>
<td>Recommended Fertilizer Dose</td>
<td>4.58</td>
<td>27.5</td>
<td>73.54</td>
<td>232.5</td>
<td>15.00</td>
<td>11.55 (19.69)</td>
<td>1:4.09</td>
</tr>
<tr>
<td>6</td>
<td>SE m. +</td>
<td>0.07</td>
<td>0.74</td>
<td>0.79</td>
<td>4.74</td>
<td>0.47</td>
<td>1.71</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>CD (P = 0.05)</td>
<td>0.21</td>
<td>2.24</td>
<td>2.37</td>
<td>14.0</td>
<td>1.42</td>
<td>5.15</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Cv %</td>
<td>12.1</td>
<td>9.84</td>
<td>14.61</td>
<td>13.70</td>
<td>8.45</td>
<td>8.52</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2.3 indicated that application of recommended fertilizer dose i. e. 200 kg N + 100 kg. P2O5 + 100 kg K2O per hectare recorded significantly an increase in number of branches (27.5), height of vine (4.58 m), maximum of vine (4.58m), maximum leaf (73.54) lakhs per hectare and weight of fresh 100 leaves recorded (322.5 gm.) and give better keeping quality of leaves (15 days) followed by application of Azotobacter 5 Kg. +
Phophonbacter 5 Kg with 100 Kg K₂O per hectare. Application of Azotobacter + Phosphobacter + 100 Kg. K₂O had given the highest net return. The potassium in fertilizers was expressed as K₂O and it was referred as potash.

2.17.7 Diseases by Application of Fertilizers

Nayak (1987) suggested that application of potash increased the yield, reduced the root rot incidence and improved the quality of betelvine leaves. Application of neem and linseed cake reduced the incidence of disease in Maharashtra.

Tryagavajan and others (1972) in Tamil Nadu observed that higher doses of nitrogen increased diseases whereas application of super-phosphate prevented the diseases.

Sen Gupta and Das Gupta (1988) observed the positive correlation between disease incidence and level of potassium applied. The diseases were more on vine when chemical fertilizers calcium ammonium nitrates at higher levels were used.

2.17.8 Pesticide Residues

Sivakumar and others (1987) reported that the residue of dicofol, wettable sulphur and eithin were estimated in/on betelvine. The residues on the first day after spray were 9.46, 5.85 and 5.39 ppm respectively. On the tenth day after spray, of dicofol, wettable sulphur and eithin residues were 0.92, 3.02 and 0.36 ppm respectively.
2.18 Disease of Betelvine

2.18.1 Foot and leaf rot (Phytophthora)

Singh and Chand (1973) estimated loss due to foot and leaf rot disease ranged from 44 to 86 per cent in Madhya Pradesh.

Mc Rae (1934) stated that in some cases entire plantations were destroyed in West Bengal due to foot and leaf rot (Physopththora).

Maithi and others (1978) reported that for the control of leaf rot cumin L; doxon and dithane m-45 was effective.

Nema (1990) observed that application of nitrogen was found to increase disease susceptibility white phosphorous and potash reduced it.

Annon. – All India Co-ordinated Research Project on Betelvine (1988-1991) were noted that nitrogen application through oil-cakes reduced the disease intensity in comparison to nitrogen through inorganic sources.

Thyagarajan et al. (1972) observed that from yard manure in combination with super phosphate considerably reduced the diseases incidence.

2.18.2 Leaf Spot – Anthrachose

Anthrachose was noted as another major disease on betel leaves which was characterised by presence of spot on leave brownish – black center and yellowish halo. The infected regions gradually became thin and dry.

Maiti and Sen (1982) reported that due to leaf spot crop loss ranged between 10 to 35 percent in West Bengal. Damage to the leaves was more serious than on the stem and branches.
Singh and Joshi (1971) reported that up to 60 percent in Madhya Pradesh and 20 to 80 percent in Uttar Pradesh the disease was visible. For the control of leaf spot – Anthrachose spraying of Bordeaux mixture (0.5 %) was quite effective in trails of All India Co-ordinated Research Project on Betelvine (1988-91).

Maiti and others (1978) suggested that the benzimidazole fungicides, Bavistin (0.10%) and benlate (0.1%) were highly effective in controlling leaf spot which was widespread in West Bengal.

Das and others (1989) reported that application of neem cake of mustard cake disease. They also further recommended application of K₂O at 125 kg per hectare annually for the disease management.

2.18.3 Steam Rot

Uppal (1928, 1930) reported that stem rot of betelvine considered to be serious in Bombay presidency (Maharashtra). Choudhary (1945) reported that it was also serious in Assam. 4 to 30 percent loss was due to stem rot.

Palakshappa (1988) reported that 30 to 42 percent in Madhya Pradesh, up to 30 percent in Karnataka.

The symptom of stem rot was darkening of the stem of the foot of the plant near to the ground level. The leaves immediately turned to yellow and became hanging and dropped of the whole vine lost freshness and at last dried up.

Choudhary (1946) suggested that the infected vine was removed from betelvine garden and deep ploughing was recommended for the successful management application of manures and fertilizers and soil amendments were required.
Meiti et al., (1985) reported that the control of stem rot application of benodanil and chloroneb was found effective. Mahapatra and Das (1990) suggested that application of toclofosmethy (0.2%) as sol drench was found effective. They also reported that soil application of T. harzianum could control the basal rot.

2.18.4 Root-Knot

Due to root-knot growth of plant was gradually affected and yellowing the leaves.

Root-Knot disease was observed in all betelvine growing states. Root knot disease found most destructive in the light soil.

Yield loss due to root-Knot was estimated to be 19 percent in Sangli (Maharashtra), 28.33 % in Jorhut (Assam), 16.80 % in Chinthalapudi (Andhra Pradesh), 20.80 % in Jabalpur (Madhya Pradesh) 37.5 % in Bhuvaneshwar (Orissa) and 50.9 % in Pusa (Bihar) were reported in annual report of All India Co-ordinated Research Project on Betelvine (1991-1992).

Acharya et al., (1988) observed that application of neem cake of one tonne per hectare reduced root-knot.

Sitaramaiah et. al., (1993) reported that the application of neem at 0.5 tonne per hectare plus carbofurum at 0.75 kg per hectare + NPK (150:100:50) was most effective in increasing the leaf yield and reducing the root-knot disease.

2.18.5 Biological Control of Foot Rot-Phytophthora

In the annual report of All India Co-ordinated Research Project on Betelvine (2000-01) reported the result of experiment carried out at Mahatma Phule Agriculture University at Sangli center concerned control of foot rot disease. The results of the
experiment suggest that the treatment of four application of Trichoderma inoculated in 500 kg oil-cake per hectare at quarterly application showed lowest foot rot intensity (12.196%) and gave highest yield of betel leaves (51.82 lakhs per hectare) with maximum return.

2.18.6 Integrated Disease Management for Betelvine

Annual report of All India Co-ordinated Research Project on Betelvine (2000-01) showed data relating to integrated disease management of Mahatma Phule Agricultural University at Sangli center that application on Sanitation + B. M. 1 % at Pre-mansoon + Biologic agent one month after B. M. application + B. M. two months after first B. M. application has give lowest vine rot (7.15 %) and reduce leaf disease and give maximum yield which was 60.78 lakhs per hectare then other treatment.

2.18.7 Growth of Mite

R. V. Nakat (1995) reported that the mulberry (Morus Alba Linn) plants acted as alternative host of red vegetable mite, T. neocaledonicus. Other live supported plants grown in betelvine garden did not support the multiplication of this mite. The survey carried out in betelvine growing areas in West Maharashtra reveled that none of the betelvine garden was free from the attack of red vegetable mite. The peak occurrence of mite was observed during pre-monsoon period in May, while the occurrence of mite was negligible during post monsoon period October.

2.18.8 Loss Due to Mite

T. neocuedonicus in betelvine was estimated to 9.7 and 19.65 percent respectively.

2.18.9 Root and Foot Disease

Naik M. K., and others (1990) studied the influence of infection by *Colletotrichum gloeosporioides* on betelvine was higher in August (disease index 49%) followed by September (43%) and July (32%) and lowest in April (2%). During the rainy season between June and September disease index was high. The low disease index during early summer was associated with low relative humidity and high temperature.

Siddappa M. K.; Anilkumar T. B. (1989) studied the root and foot rot of betelvine and its control. The root and foot of betelvine was caused by *Fusarium solani* was severe problem in Karnataka. Several fungicides like carbendazim emisin and thiram were tried to control the pathogen in various type of soils. The activity of fungicides was relatively less in latertic soil as compared to red loam soil and black cotton soil.

Nayak M. L.; Wasnikar A. K. (1989) reported that susceptibility decreased gradually with the increase in betelvine leaf age. In old betel leaves, the population of bacteria remained relatively low after inoculation as compared to young leaves.

Hiremath P. C. and others (1987) carried out, survey showed that none was free from disease caused by *Colletotrichum gloeosporioides* incidence was 11 percent to 19 percent.

R. V. Nakat (1995) reported that the application of predatory mite, *Amblyscius Largoensis* and thrip, *Scolothrip Spp.* In betelvine garden gave better results in the management of red vegetable mite *T. Neocaledonicus* being potent natural biocontrol agents.
2.18.10 Bacterial Leaf Spot

Anon, All India Co-ordinated Research Project on Betelvine (2000-01) reported that maximum and minimum temperature, relative humidity, bright sunshine hours and rainfall had positive correlation while as number of rainy days and number of cloudy days had negative correlation effect on disease in cadence at Assam Agricultural University.

In the annual report of All India Co-ordinated Research Project on Betelvine (2000-01) explained that near about 18 percent yield loss was due to tobacco caterpillar at Acharya N. G. Ranga Agricultural University, 12 percent loss was due to mite at Mahatma Phule Agricultural University and 51 percent yield loss was due to scale insect at Tamil Nadu Agricultural University were observed.

2.18.11 Precaution in Case of Mite Infection

R. V. Nakat (1995) reported that it was necessary to plucking of infested leaves along with mite at weekly interval which reduced 39.90 percent mite infection.

Gupta (1991) suggested the cultural practices such as removing of inter cropping of non-host crops, collection and destruction of damaged leaves and plant parts and adoption of clean cultivation.

R. V. Nakat (1995) suggested that need based spraying dicofol 0.05 percent, wettable sulphar 0.5 percent, phosphamidon 0.05 percent, malathion 0.05 percent and tobacco decoction 2 percent were significantly superior to control mite infection on betelvine.
2.18.12 Economics of Pesticides Treatment

R. V. Nakat (1995) reported that the highest net return of Rs. 11,112 was obtained from treatment with dicofol 0.25 percent. Application of Phosphamidon gave return of Rs. 7197 and wettable sulphar was Rs. 6668. The highest cost benefit ratio (1:12:36) was recorded by application of phosphamidon.

Shivkumar and Marimuthu (1987) also reported that maximum yield of betel leaves was obtained in the beds sprayed with dicofol.

R. V. Nakat (1995) also reported application of dicofol gave the maximum yield of 40.10 lakhs leaves of betelvine (320.80 Dag) followed by 37.58 lakhs leaves of betelvine (300.64 Dag) in phosphamidon and 37.31 lakhs leaves of betelvine (298.48 Dag) in wettable sulphur. Highest marketable betelvine leaves were obtained from the treatment of dicofol.

2.19 Betelvine Leaf Size and Weight

In the annual report of All India Co-ordinated Research Project on Betelvine (2000-01) explained that twenty two betelvine clones were collected and stored in the farm of Mahatma Phule Agriculture University at Sangli center. Data revealed that leaf size, leaf area and weight of leaves were more in case of Bangla variety compared to Kapoori variety Ghaneghatte and Bangla Banarasi ranked to in the leaf size (19.50 x 17.20 cm. and 18.60 x 16.20 cm. respectively) and leaf area (278 cm2 and 261 cm2 respectively). The leaf yield was maximum in case of SB-37 (448 number of leaf).

In the annual report of All India Co-ordinated Research Project on Betelvine (2000-01) reported the result of experiment carried out at Mahatma Phule Agriculture University at Sangli.
center concerned control of foot rot disease. The results of the experiment suggest that the treatment of four application of Trichoderma inoculated in 500 Kg oil cake per hectare at quarterly application showed lowest foot rot intensity (12.19%) and gave highest yield of betel leaves (51.82 lakhs per hectare) with maximum return.

2.20 Harvesting of Betel Leaves

Das and Banarjee (1984) estimated that in West Bengal, betel leaves were yielded 2.4 million leaves per hectare annually from second year onwards, whereas from Meetha leaves the corresponding yield was 0.05 and 0.58 million leaves respectively.

In Maharashtra, harvesting six month after planting or two months after first lowering with skilled labour using a small iron blade attached to thumb. Plucking of betel leaves required on expert hand with the help of an artificial thumb nail made by iron. The leaves were cut along with the stalk about on cm. length.

Betelvine leaves increased from the second year upto fifth years. From fifth year, the yield was reduced year after year. The total survival of betelvine garden ranged up to eight to ten years.

Singh and others (1988) suggested that the leaves matured after six to eight weeks. Such leaves become ready for harvest.

2.21 Grading of Leaves

The betel leaves were packed according to size, colour, texture and maturity on which the chewing quality depended. Grading was done in different ways in different areas.
Grading of betel leaves was dependent upon their position on the vine, their maturity and place of production.

Chaugule and others, loc. cit; stated the grading in some parts of Deccan that the new betel leaves were called as Navati, the second plucking of leaves as Parati and third plucking was known as Terti.

The leaves were assembled from the branches called as Hatvan which were considered as the best for chewable. The betel leaves, those at the nodes on the main stem, were called as Angwan which were also called as fapada. Those betel leaves, kept on vine to mature for a long time, were called as Junwan. The leaves which were gathered from lower part of the vine were called as Hakkal and they were mostly consumed locally. Harvesting of leaves was done three to four months after new plantations and subsequently of three to four weeks intervals. The leaves that were born on the branches were called as kalli leaves.

2.22 Packing of Betelvine Leaves

Iruthayaraj, Malelu, Chowdhari, Macra, Agricultural Journal; 1945, 33(3&4), 49; Krishna and Kantiraj, ibid; 1941 29 (1) 12; Bull. Indian Concon comm.; 1955-56 9 (2), 54. They explained the packing practices of betel leaves. The plucked leaves after washing cleaning and counting were arrange in the basket. The unit of sale in chinglepur district in one kavali 100 leaves was contained. In Coimbatore, one kavali contained 200 leaves. The unit of packing was one Palagai containing 2000 leaves.

2.23 Bleaching of Betelvine Leaves

Patra (1987) reported that in some areas of the Midhapore district of West Bangal the betel leaves of Birkuli and
Chandrakona varieties were bleached (processed), leaves of other varieties were not suitable for this system. Some times, the betel leaves were processed by applying pressure. The processed betel leaves fetched higher price.

2.24 Cost of Betelvine Cultivation

Vikas Singhal (1975) was explained that for the cultivation of betelvine in the first phase for a new set-up cost came to Rs. 2.5 lakhs per hectare. The cultivation of betelvine was carried out in small holdings in almost all, except the north-west parts of the country. In Ayurvedic medicine, the oil of betel leaves was used in gargle; diphtheria also used local application.

R. K. Chourasia (2001) explained the economics of betelvine cultivation of Desawari variety in closed conservatory of 0.4 hectare. Author considered total cost of cultivation of three subsequent years. Total cost of cultivation of the first year was estimated at Rs. 18,350 in the second year the cost was estimated at Rs. 72,325 and the next year it was estimated at Rs. 72,985. In the first year initial investments required more as compared to second and third year. The aggregate cost of cultivation for three years was Rs. 3,26,660. From the aggregate cost of cultivation the value of asses at the end of third year was Rs. 24,500 which was deducted from the aggregate cost. The aggregate net cost comes to Rs. 3,02,160.

M. Karunakav Babu and others (1993) reported the cost of cultivation of betelvine for open type in Andhra Pradesh. The cost of cultivation per year was amounted to Rs. 65,000 in the first year. During the second and third year it was estimated at Rs. 60,000 respectively.
S. Natarajan and others (1973). All India Co-ordinated Research Project on Betelvine in Sirugamani of Tamil Nadu reported the total cost of cultivation of betelvine of one acre for two years amounted to Rs. 1,45,000. They also reported per acre cost of cultivation of first year which included preparatory cultivation amounted to Rs. 925 (0.84%), sowing standards Rs. 975 (0.89%), irrigation cost Rs. 6,000 (5.48%), after cultivation cost Rs. 1,550 (1.42%), planting and cost of seed vines Rs. 12,775 (11.67%), after cultivation second year Rs. 39,370 (35.95%) manures 9,215 (8.42%), plant protection Rs. 10,690 (25.57%) lease amount of two years was charged Rs. 36,000.

Samiyappan and others (1984) reported the comparative study of three commercial crops viz. Betelvine, banana and sugarcane. They observed the cost of cultivation to be the highest on betelvine. They also reported that the farm income per acre was 4 to 6 times higher than those of banana and sugarcane.

Gadre and Gaigalikar (1984) carried out a survey in Anjangaon in Maharashtra to workout cost of cultivation per hectare in regard to betelvine. They reported that the total cost incurred on betelvine plantation was the maximum i.e. 20.11 % of the total cost. The input-output ratio was worked out which was 1.00 : 2.10 which was fairly high. They further observed that family and higher labour taken together account for 35.19 % of the total cost of betelvine cultivation. This was the labour intensive occupation.

Meenaxisundaram (1987) had given total cost of cultivation of betelvine in Tamil Nadu per hectare it was Rs. 2.07 to 2.58 lakhs. The cost analysis also showed that 29.20 % and
43.90% of the total cost was on account of labour cost in Salem and Madurai districts.

Hinge and others (1987) in Nasik district of Maharashtra reported that the total cost of cultivation of betelvine was worked out which was 1.25 lakhs per hectare. The labour cost was 22.59 % of the total cost.

Gadre and Galgalikar (1984) examined that in Vidarbha region in Maharashtra, the cost of production of betelvine leaves amounted to Rs. 22.79 per basket of 3000 leaves and Rs. 136.95 per bundle of 6000 leaves in Nasik (Hinge and others, 1987) where as it was Rs. 27.11 per kg in Mohoba in Uttar Pradesh.

Meenaxisundaram (1987) reported the cost of production of betelvine leaves in Tamil Nadu was Rs. 6.41 to Rs. 6.93 per kg.

Das and Banerjee (1984) reported that the cost of production of betelvine leaves in West Bengal was Rs. 29.93 per thousand Bangla leaves and Rs. 63.93 per 1000 Meetha leaves.

**2.25 Marketing and Storage of Betelvine Leaves**

The transfer of betel leaves from cultivators to ultimate consumers executed through various middlemen. Betel leaves were marketed as early as possible after harvesting.

Bull cent. Fd. Techno. Res. Inst. Mysore (1955-56) 5,194; Iyengar and others; big (1955-56)5, 307 reported that betel leaves were stored in cold storage at a temperature of 5°-7 ° the storage life of unpacked leaves extending upto eight day. They also recommended that betel leaves were packed in polyethylene bags.
2.26 Pan Become Expensive

On 2\textsuperscript{nd} February; 2006, Pudhari, a noted Marathi daily newspaper published special report on the price of betel leaves. Due to lowering of betelvines and less supply of betel leaves from local cultivators and from Madras, there was a historical rise in the price of betel leaves in Sangli, market. The price of one dag (12000 leave) was increased by Rs. 700 within two to four days. During February to May price of betelvine leaves were mostly dependent upon the supply of Madras leaves. In the Sangli Market the supply of betel leaves was mostly from Miraj and Walva tehsils. Rate of one Kavali (300 leaves) was Rs. 60 and later on the rate was increased to Rs. 90 within two to four days. Hakkal betel leaves got proper rate upto Rs. 500 per dag. Before inflation the rate of Hakkal betel leaves was Rs. 300 local betel leaves were also supplied in Bombay. Shrirampur and Gujarat market which caused to increase the rate of betel leaves. Sambhaji Shingade, the vendor of betel leaves, expressed his opinion that such type of rise in the rate of betel leaves never happened in the last 50 years.

2.27 Income from Sale of Betelvine Leaves

After harvesting of betel leaves as early as possible, it was necessary to send the leaves to the market for sale. Betel leaves were perishable in nature. Some times due to over supply of betel leaves in the market, growers were unable to get remunerative price: During mansoon, i. e. June – September three was excess supply of betel leaves. The price in this season was generally low. In the month of January, lowering activities were carried out in various betel vine gardens. It affected the supply of leaves. During the January-April period, the price of the betel leaves was moving towards high. The price was always settled on
the basis of the quality of leaves. The price depended on the supply and demand. However, during the festivals, marriage seasons, ceremonial celebrations, the demand for betel leaves was more. The sale of betel leaves was done either through auctions or through negotiations.

R. K. Chourasia (2001) estimated the sale of leaves of three subsequent years for one acre the sale was considered from April-June, July-October and November-February. It was considered that three was no sale of betel leaves in the month of March due to lowering of betel vines. In the first year, sales were estimated at Rs. 1,25,100. Total aggregate income of three years was Rs. 5,46,100. The total net income was Rs. 2,43,940. The annual net income from cultivation of betelvine leaves was calculated at Rs. 81,313 for one acre.

M. Karunkar Babu and others (1993) reported that during the first year betel leaves yielded about 75,000 panthas (panthas means 100 leaves) per hectare in six harvests. During the second and third year, betel leaves yielded annually about 1,00,000 to 12,500 panthas per hectare in 10-12 harvests. The average rate was considered at Rs. 2 per pantha in the first year whereas in second and third year average rate was at Rs. 1.50 per pantha Gross annual income form sale of betel leaves of the first year was Rs. 1,50,000 and in the second year it was Rs. 2,00,000 and in the third year it was Rs. 1,87,500.

S. Natrajan and Nagalakshmi (1993) reported that net amounted to Rs. 1,07,875. Annually net income from one acre of betelvine amounted to Rs. 53,937.50.
They also recommended that if proper care and maintenance were taken in the cultivation of betelvine, maximum returns were possible which always higher then any other crop.

Samiyappan and others (1984) reported the comparative study of three commercial crops viz. betelvine, banana and sugarcane. They observed that the net income per acre of betel vine was 10-11 times more them of banana and sugarcane respectively.

Hinger and others (1987) in Nasik district of Maharashtra reported that net profit was Rs. 32,438 per hectare and 2952.50 man days were required for per hectare.

2.28 Return from Betelvine Crop

Dr. V. B. Rahudkar (1992) reported that annual net profit from sale of betel leaves was Rs. 75,000 to 90,000 per acre. 0.10 acre under betelvine cultivation were economical beneficial.

2.29 Price Spread

Balasubrahmmanyam and Chaurasia (1990) carried out a study on the price spread for betel leaves to determine the share of producers in the rupee of consumers. Betelvine growers got low share due to high marketing charges, many number of intermediaries collected their abnormal commission. According to their research studies, the total marketing expenses were as high as 35.41 percent of the price charged to consumers. Betelvine growers got only 65.59 percent as their share of the rupee of consumers.