CHAPTER V

TECHNOLOGICAL CHANGES IN NATURAL RUBBER PRODUCTION
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Technology has been singled out as the most dominant variable affecting agricultural productivity and development. The productivity gains, provide a combination of increased profit to land owners, increased demand for labour and consumer benefit from lower prices. Like any other agricultural crop, natural rubber also witnessed changes in the technology of production. The present chapter examines the technological changes experienced in the rubber plantation industry in India.

It is widely accepted that one of the major reasons for the improvement in agricultural productivity was technological change. The technological changes experienced in agriculture include improved varieties of seeds, mechanisation of agricultural operations, use of chemical fertilisers, insecticides etc. Mechanisation of agricultural operations was a major development in many annual crops. However, in the case of plantation crops, the scope for mechanisation was limited and was rarely found. New improved inputs like HYVs, fertilisers and pesticides have also been increasing the yield of cultivated areas. The high yielding varieties of seeds have a higher rate of yield compared to the
traditional ones for a given level of complementary inputs. Higher resistance to certain crop diseases and marginal reduction in the duration of the crop are some other advantages of the high yielding varieties. Many crops were affected by various pests which could be eliminated by using chemical pesticides. The application of plant-protective pesticides indirectly contribute to increased output by preventing crop losses at various stages.

India experienced considerable improvement in agricultural technology since independence. Of particular importance, has been the introduction of high yielding varieties. The use of high yielding varieties was supplemented by improved cultivation practices and there has been wide acceptance of chemical fertilisers, pesticides and herbicides, often specially developed for particular crops for particular environmental conditions. The wheat and rice and coarse grains have been capable of high yields with the aid of fertilisers, pesticides and adequately controlled water supplies. They were produced by means of genetic and agronomic "engineering" carried out in international and national research centres.¹

The use of new varieties, has been accompanied by an increasing degree of mechanization. Some examples are the use of tractors for rapid land preparation, of permitting increased double-cropping, of mechanical threshers to handle the greatly increased harvest, and of motor pumps to lift irrigation water. Productivity improvement takes place in agricultural crops by a combination of breeding better varieties, extension and improvement of irrigation, more intensive fertiliser use and mechanisation.

Higher crop yields from improved technology has been a major source of growth in rubber production, the other factor being growth in area under rubber cultivation. In Kerala, the homeland of rubber cultivation in India, any sizable improvement in output cannot be achieved by bringing more and more new area under cultivation because of the limited availability of cultivable land. Therefore the main source of growth in production in the future is, of course, growth in productivity.

The Indian natural rubber industry, has over the years, evolved a system of research capabilities that has generated a stream of indigenous technology. At times, the industry has
adopted better technologies developed elsewhere, which were found to be suitable to our conditions. The productivity in rubber plantation industry depends not only on the advancement of technology, but also on the proper diffusion of new technology among the growers. Adoption of new high yielding cultivars and associated package of improved techniques has been wide spread. The associated package of improved techniques include discriminatory fertiliser application, scientific cultural practices, introduction of rain guards, application of yield stimulants and scientific tapping. It is interesting to note that majority of these factors were not considered to have any significant impact on productivity during the early years of plantation production. For example, Ashplant\(^2\) states that the yield of rubber tree, is influenced by a variety of factors such as the tapping system, frequency of tapping, efficiency of tapping and by the age of the trees as well as the soil and the climatic conditions of the district. Thus it is clear that the knowledge of the productivity determining factors was entirely different in the initial years of rubber cultivation in India.

\(^2\)Ashplant Herbert (1921), *Para Rubber*, Department of Agriculture, Kampala, p.7.
Planting Materials

The selection of the material to be planted is important in the cultivation of any crop. This is all the more significant in the case of a perennial crop like rubber, as the decision of the type of planting material has an effect for about thirty years. Information on the relative performance of various planting materials helps the planters in arriving at the correct decision about planting.

All the old rubber plantations in the Far-east have originated from one source viz. seeds brought by Sir Henry Vickham in the latter part of the nineteenth century from the Amazon valley in Brazil. Practically, all trees originated from this seeds which were low yielding. Research on breeding and selection was started by the various rubber research institutes in Java, Sumatra, Malaya, Ceylon and India.

Increase in yield was largely brought about by the development of several high-yielding clones or budgrafts. In the early days of the plantation industry, only unselected seedlings were available for planting. These unselected seedlings were
capable of giving yield of no more than 200 to 300 pounds per acre per year under the most favourable conditions. As years passed, the unselected seedlings slowly gave way to selected seedlings of higher yield. These selected seedlings were mostly mono-clonal seedlings of which a fine example is Tjir seedlings. These selected seedlings were capable of producing on estate scale, up to 1000 or even 1500 pounds of dry rubber per acre per year under favourable environmental conditions.

One of the main characteristics of the unselected planting material was its yield variability. The yield of the trees varied considerably. As the planters shifted to selected seedlings, the output from their progeny was higher than that of the completely unselected seedlings. Still the variability was significant. The extra yield was also not much higher in majority of the cases because the selected mother tree has often cross pollinated with poor fathers adjacent to them.

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4 ibid
A major breakthrough in the production of high-yielding clones was the development of the technique of budgrafting. As early as in 1916, a Dutch Scientist, Van Ehlten, successfully grafted buds from selected high-yielding trees on to the seedling stocks. The trees thus obtained are known as clones, or plants whose scion - that part above the root stocks - is obtained by negative propagation. Their main characteristic is similarity in all important features such as yield and habit of growth and in other aspects such as the shape of the seed and markings on its coat. The planters were over-enthusiastic about the possibilities of yield enhancement. It was readily believed that by budding from the existing best yielders would straight away, in the first generation, provide plants capable of yielding 2000 to 3000 pounds per acre per year.

**Significant advances in the breeding of high-yielding clones were made in the fifties. Notable contributions in the**

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5 Barlow C., op. cit., p.116.

development of high-yielding clones were from the Rubber Research Institute of Malaysia (RRIM) and Rubber Research Organisation of Indonesia. The high-yielding clones developed in the above research institutes were subsequently adopted by the farmers in India. Breeding of high clones started in India in 1954 when the Rubber Research Institute of India was started. The institute has been able to evolve some high-yielding planting materials like RRII-105 and RRII-208. These clones have been evolved by hand pollination and selection which were developed in the small scale trials during 1956-1961. The plants in these trials came into bearing from 1963 onwards. The promising performance of these plants in the initial years of production encouraged the Rubber Research Institute of India in releasing it to planters for experimental planting in the late sixties and subsequently for commercial planting by the middle of seventies. Unlike in the case of other plantation crops, the various countries engaged in the production of natural rubber was able to work out an international clone exchange programme. The co-ordination of the clone exchange programme was done by the International Rubber Research and Development Board. This enabled the natural rubber producing countries to exchange high yielding planting material for multiplication, trials and planting. This approach has helped in eliminating the repetition of efforts and saved much time which
have been used for further useful research. This unity among the rubber producing countries have greatly contributed to the advancement of the plantation industry.

In the fifties and sixties, the only objective of Hevea breeding was improvement in yield per tree. During these days, the scientists were not interested in other factors affecting rubber production like disease resistance, drought tolerance, wind resistance etc. But by the seventies the research work started in this direction too.

Reduction of Immaturity period

Development of planting materials with reduced immaturity period was given an important place in the research programmes of the Rubber Research Institute of India in the eighties. The immaturity period denote the unproductive phase extending from the time of field planting to the commencement of tapping. Therefore, reducing the immaturity period has got great significance in the economics of rubber cultivation. Reduction in immaturity period has at least two benefits viz. early income and the replacement of old less productive trees by new high yielders, thereby providing more earnings from each hectare.
In the early fifties, the gestation period for rubber in India was about ten years. At present, a great majority of small holdings as well as estates take about seven years for attaining the criteria of tappability. However, the current expectation of the immaturity period among Malaysian growers is only five and half years. It was reported by some estates during the survey that the immaturity period was reduced to about four and half years on an experimental scale.

Apart from the type of planting materials, other cultural operations are equally important in reducing the immaturity period. Experiments done in the Rubber research Institute of India have shown that reduction of immaturity period in rubber can be attained by improved nursery techniques, using advanced planting materials, timely manuring coupled with irrigation, establishing good cover crops, adopting better plant protection and other cultural operations.

A much higher yield could be achieved if the environmax concept is put into effect. The environmax concept envisages use of planting materials suitable to a particular environment. It is interesting to note that one particular clone, RRII 105 - has been extensively planted throughout the country without regard to the environment in which it is planted. Farmers usually turned to this clone because of its high yield potential. The high yield potential makes the planters to overlook other factors to be considered before taking a decision on the planting material. The difficulty in putting into practice the environmax concept in India is that the number of clones available for major planting is insufficient. It is important that the environmax concept be closely followed by the farmers, both small and large, so that the appropriate clone is planted in the right environment to ensure adaptability and high yield. It is in this line that the research and extension work of the Rubber Board have been directed in the recent years.

Manuring

In the earlier days of rubber cultivation, manuring was seldom done in rubber plantations, as it was not considered necessary. But the need for proper and regular manuring in the
immature and mature rubber areas is now well recognised by the growers. Fertilizer application to the young rubber tree during the pre-tapping stage is for accelerating growth, there by reducing the non-productive immature period. Fertilizer treatment to mature rubber trees under tapping is designed to increase productivity of the trees. Healthy and rapid renewal of the bark is a vital problem in rubber plantations and this depends greatly on the nutrient supply. Manuring in the broad sense aims at making available all the essential nutrients deficient in soil at optimum levels.

The Rubber Board has been helpful in spreading the concept of fertilizer usage among the rubber growers. Even though their extension activities were helpful in this movement, a financial subsidy scheme launched by it has not found much favour with growers. As per the scheme, a 50 per cent subsidy was given on the cost of fertilisers purchased from co-operative societies and applied in immature areas planted with high yielding materials. The main reason that made the scheme unattractive was that most of the small holdings were interplanted or inter cropped and as per the scheme, such holdings were not eligible for the subsidy.
Table 5.1
ESTIMATED AREA UNDER THE USAGE OF FERTILIZERS IN THE RUBBER PLANTATION INDUSTRY IN INDIA, 1986-87.

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Area (hec.)</th>
<th>Estimated Area Manured (hec.)</th>
<th>Percentage of Area Manured (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMALL HOLDINGS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Mature area HYV</td>
<td>179500</td>
<td>107700</td>
<td>60</td>
</tr>
<tr>
<td>2. Mature area non HYV</td>
<td>35000</td>
<td>8750</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td><strong>Total Mature Area</strong></td>
<td><strong>116450</strong></td>
<td><strong>54</strong></td>
</tr>
<tr>
<td>IMMATURE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Upto 4 Years</td>
<td>40000</td>
<td>32000</td>
<td>80</td>
</tr>
<tr>
<td>4. 5 - 7 years with cover crop</td>
<td>10250</td>
<td>8200</td>
<td>80</td>
</tr>
<tr>
<td>5. 5 - 7 years with cover crop</td>
<td>16750</td>
<td>13400</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td><strong>Total Immature Area</strong></td>
<td><strong>53600</strong></td>
<td><strong>80</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Total area under small holdings</strong></td>
<td><strong>170050</strong></td>
<td><strong>60</strong></td>
</tr>
<tr>
<td>ESTATES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature HYV</td>
<td>50000</td>
<td>40000</td>
<td>80</td>
</tr>
<tr>
<td>Upto 4 years</td>
<td>8000</td>
<td>8000</td>
<td>100</td>
</tr>
<tr>
<td>5 - 7 years</td>
<td>10000</td>
<td>10000</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td><strong>Total for Estates</strong></td>
<td><strong>58000</strong></td>
<td><strong>85</strong></td>
</tr>
<tr>
<td>NURSERIES</td>
<td>750</td>
<td>750</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>222700</strong></td>
<td><strong>64</strong></td>
</tr>
</tbody>
</table>

Source: Rubber Board, Kottayam.
It was estimated that around 51000 tonnes of artificial fertilizers worth Rs.114.75 million was consumed by the industry in 1987-88. The major artificial fertilizers consumed by the industry are Urea, Phosphate, Potash, Magnesium sulphate, Ammonium sulphate and Factomphos. Average dosage per hectare for India in 1988-89 was 25.15 kgs of Nitrogen, 23.90 kgs of Phosphorus, 19.08 kgs of potassium and 0.62 kgs of magnesium. For this, it was estimated that 9571 tonnes of Nitrogen, 9094 tonnes of phosphorus, 7759 tonnes of potassium and 236 tonnes of Magnesium were required for the industry.

Table 5.1 shows that fertilizer application was not as widely practiced in the small holding sector as in the estate sector. While only 60 per cent of the area in the small holding sector was subject to any kind of fertilizer application, the corresponding figures for the estate sector was 85 per cent. The gap between estates and small holdings in the use of fertilizers was found for both the mature and immature areas. The table also shows that the area under high yielding varieties were largely

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subjected to fertilizer application. This is in contrast to the area under non high yielding varieties where only a small percentage was using fertilizers. From the forgoing analysis, it is clear that in the usage of fertilizers, the small holding sector was far behind the estate sector.

The yield response to fertilizer application varies from place to place depending upon factors such as clonal variety, climate, soil types, soil nutrient status, leaf nutrient content, manuring history and existing ground condition. However, scientifically no sound and systematic fertilizer policy was followed by the industry till 1957, probably due to non-availability of proper manurial recommendation suited to local conditions to be followed by rubber growers\(^9\). In 1957, Rubber Board issued the first general fertilizer recommendation taking into consideration the agro-climatic condition in the rubber growing regions in India. Improvements were made in the manurial recommendations in the later years.

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Fertilizer application, one of the most important items of expenditure in the rubber plantation, has the specific objective of obtaining maximum economic benefits, through minimum investment. To attain this objective, the fertilizer usage should ensure maximum enhanced early growth which will in turn reduce the unproductive immature period with subsequent economic benefit of getting early returns for the huge investment. In addition to this, achieving maximum economic yield increase throughout the life span of the plants should be an objective. A distinction can be seen between the growth of the immature plants and mature trees. Enhanced early growth of the immature plants can be achieved by adopting the general fertilizer recommendations and the second objective can be fulfilled by adopting a discriminatory fertilizer application. It was observed by Pushparajah\(^1\) that in addition to giving better growth and yield, major nutrients also affected the quality of the latex produced.

Discriminatory Fertiliser Application

It is now well recognised that the possibility of getting responses in yield to fertiliser application for mature rubber depends on the factors such as present yield and yielding capacity of the planting material, the age and condition of the trees, tapping history, the nutrient supply capacity of the soil, the nutrient status of the trees and manuring and soil management history. Therefore it is necessary to consider all these factors before applying fertilisers. For the efficient and economic use of fertilisers, discriminatory fertiliser application based on the results of fertiliser trials and soil and leaf analysis is essential in order to obtain maximum economic benefits from the fertiliser applications. Such a practice could result in use of lower amount of fertilisers or increased returns from the same investment in fertilisers. It was estimated that 10 to 20 per cent increase in yield is obtained merely by adopting discriminatory fertiliser application.\footnote{Mukundan Menon P. (1989), "Short Term Techniques for Boosting Rubber Productivity", Rubber Board Bulletin, Vol.24, No.4, p.29.} But the studies conducted showed that while about 59 percent of the estates practiced it, only 11.25 per cent of the small holders adopted such a practice.
Table 5.2
PERCENTAGE OF ESTATES AND HOLDINGS, WHERE SOIL AND LEAF ANALYSIS IS IN PRACTICE

<table>
<thead>
<tr>
<th>Type of Ownership</th>
<th>Percentage of estates in which S/L. analysis is practised (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESTATES</td>
<td></td>
</tr>
<tr>
<td>Government Estates</td>
<td>86</td>
</tr>
<tr>
<td>Public Limited Companies</td>
<td>83</td>
</tr>
<tr>
<td>Private Limited Companies</td>
<td>33</td>
</tr>
<tr>
<td>Partnership firms</td>
<td>63</td>
</tr>
<tr>
<td>Proprietorship firms</td>
<td>42</td>
</tr>
<tr>
<td>Religions Estates</td>
<td>63</td>
</tr>
<tr>
<td>SMALL HOLDINGS *</td>
<td>11.25</td>
</tr>
</tbody>
</table>

Source: For estates, Sudarsanan Pillai P. op. cit.
Note:* The Data refers to Smallholdings in Meenachil Taluk, a prominent rubber growing area. Source: Michael, T.T., op. cit.

It should be noted that a large majority of the small holders did not go in for discriminatory fertiliser application even in one of the prominent rubber growing regions in Kerala, were the study was conducted. Table 5.2 reveals the failure on the part of the

\[\text{\textsuperscript{12}}\text{The data for small holdings refers to Meenachil Taluk in Kerala, which is one of the prominent rubber growing regions in the country.}\]
extension wing of the Rubber Board in spreading the technology of discriminatory fertiliser application which is economically advantageous to the growers.

Plant protection

Effective protection of rubber trees against the ravaging diseases which cause considerable economic loss, engaged the serious attention of the scientists. For their spread, if unbridled, leads to decline in yield and loss of many trees. The major fungal diseases in India are abnormal leaf fall disease, the shoot root disease and powdery mildew. The abnormal leaf fall disease, caused by the fungus phytophthora is a disease annually recurring during the months of June, July and August. The fungus infects the leaves, fruits and small twigs of the plants. It was observed that while all high yielding clones and clonal seedlings are highly susceptible to this disease, the effects on the unselected seedlings were not so severe. Presently all rubber growing regions in India, except the Kanyakumari district of Tamil Nadu.

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Nadu is ravaged by the abnormal leaf fall disease. It is estimated that the yield loss due to this disease in high-yielding trees is about 30 - 50 per cent. The incidence of abnormal leaf fall was first noticed in the year 1910, within a few years of the commencement of rubber cultivation in India. In the early days of rubber cultivation, high volume spraying using Bordeaux mixture was recommended for the control of this disease. This is a laborious, time consuming and costly operation. An alternative method of spraying is using micron 420, Mini Micron 77 or saw duster/sprayer. For estates, this too is a slow operation since it could cover only 4 to 5 hectares per day. A faster method is aerial spraying. The first field trial on aerial spraying was carried out in the year 1960. Commercial aerial spraying started in the year 1963. Small helicopters with a capacity of 120 to 170 litres of spray mixture are now being replaced by helicopters capable of carrying 300 to 350 litres. Estates usually carry out aerial spraying to check the disease. Small holdings cannot go in for aerial spraying and they require sprayers. Manual spraying involves large quantities of water, which is often impracticable during the dry-spraying season and climbing up of individual trees necessitating the deployment of large labour force. The cost of power sprayers is very high and can be ill-afforded by individual small holders. In 1987-88, the rubber plantation industry
consumed about 1000 tonnes of fungicides worth Rs.38 million. One of the measures that can be taken to improve the plant protection practices among small growers is to help groups of small growers in purchasing power sprayers. The rubber producers' societies started recently can do a lot in this regard.

Another major disease affecting the rubber plantations is the powdery mildew disease. This disease can be checked by dusting using sulphur dust. Apart from the above diseases, the rubber trees are also subjected to a number of diseases which affect stem and bark. Panel protectants and other fungicides are used to control these diseases.

An important point to be noted in this regard is that even though the scientists were successful in evolving some disease control measures and the farmers were progressively adopting it, little progress has been made in breeding clones resistant to diseases. The emphasis on higher yields seems to have encouraged some diseases and stimulated some previously unknown diseases. The emphasis of research in this area needs to be in evolving clones capable of resisting the diseases commonly found in India. The environmax concept of using planting materials suitable to particular environment will be helpful in this aspect also.
Tapping System

Rubber Trees have an economic life of about thirty years and the cost of establishment of these trees are very high. Therefore the selection of the exploitation technique is very important. The industry emerged into its modern form when systems of tapping based on excision of the outer bark were developed by H.N. Ridley in the last decade of the nineteenth century.

In India, tapping of rubber trees generally starts seven years after planting. After commencement of tapping, the virgin bark is invariably used for twelve years and the first renewed bark for another twelve years and intensive tapping and slaughter tapping for another 4 to 6 years. Tapping is a skilled job. Correct timing, maintenance of proper angle of incision and deep yet damage-free tapping are important for full exploitation of yield potential. Attempts to replace the skill of the tapper with machine is not advisable for a country where labour is cheap and abundant. Mechanisation of tapping should be given only low priority.

The ideal tapping system is the one that combines maximum yield and minimum cost with best growth and bark.
development. No clone evolved so far has the capability to stand daily tapping. Daily tapping results in drastic retardation of growth and high incidence of brownbast. But a number of small holdings, practice daily tapping. The widely adopted system of tapping is half spiral, once in two days $1/2 \cdot s/2 \cdot d/2$ with or without sunday rest. A section of growers have now switched over to tapping once in three days. Earlier the criterion of tappability was the age of the trees. Now, importance is given to size of the trees rather than its age. In order to improve the system of tapping in rubber plantations, Rubber Board has started giving training to tappers and small growers. Tappers' training schools were started in different parts of the country for providing training to tappers and small growers. These tappers' training schools are run by the Rubber Board.

Weeding

The problems due to weed growth are serious in rubber plantations. Weed growth is particularly harmful in rubber nurseries and in immature areas. Weed control is an important and costly cultural practice in rubber plantations. It is essential to keep the plantation completely devoid of weeds both in the nurseries and immature areas to facilitate good growth and also
for establishing leguminous ground covers. Timely sowing of cover crops and bimonthly weeding of interrows for the first two years would facilitate the establishment of good cover crop. This could limit the weeding to planting strips and selective slashing of weeds in interrows.

From 1970s chemical weed killers or weedicides are being used by large estates to a limited extent. It was observed by Mathew et al.\(^\text{14}\) that the use of weedicides is helpful in controlling weeds in the planting strips in the seedling nursery. Rubber plantations are affected by several types of weeds and till now no single weedicide have been evolved in controlling all the weeds in rubber plantations. But a suitable combination of two or three weedicides can effectively control the weed growth. The combination being determined by the dominant type of weed population.

Chemical Stimulation of Yield in older plantations

Stimulating rubber trees with the chemical ethephons (2-chloro ethyl phosphoric acid) is one of the most important and comparatively recent agricultural technologies developed to increase the efficiency of production in the natural rubber industry. The application of this chemical is capable of boosting rubber yields by 20 to 50 per cent of well-kept trees in tapping for more than fifteen years. The yield response on stimulation depends on many factors such as type of clone, age, nutrient status of the tree, tapping system, method frequency of application of stimulant etc.

The earliest attempt to stimulate rubber trees was by periodic scraping of the bark below the tapping groove. In 1929-30, experiments for evolving yield stimulants were conducted by the Rubber Research Institute of Malaysia using a mixture of cattle manure, wood ash, sulphate of iron and permanganate of potash. By the 1950s chemicals were used by the estates for the stimulation of trees. They used phenoxy acetic acids 2,4-D and

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15 Mukundan Menon P., op.cit., p.29.
2,4,5-T. It was in the late sixties that ethylene was used for this purpose. The stimulant now widely used, ethephon, is an ethylene inducer. It was commercially introduced in the seventies and is now widely adopted by estates as an effective means of increasing productivity. Although production cost increases with yield stimulation, the increase in yield, particularly in the older tapping panels, often offsets the increase in production cost and hence a higher level of operating profits can be obtained.

Rain Guarding

If tapping is not done during rainy season, the number of tapping days will be reduced to about 100 to 120 days in holdings where the alternate daily tapping system is followed. Tapping can be carried out during rainy season by fixing rain guards to the trunk above the tapping panel. Rain guarding makes it possible to tap each tree for an extra 30 to 40 days per year under once in two days system and it is expected to increase the yield by about 10 to 15 per cent\(^{16}\). A study conducted by the Rubber

\(^{16}\) Mukundan Menon p., op cit., p.29.
Board has shown that the yield per hectare, justifying the adoption of rain guarding is 675 kg/hectare.

Cover crops

Rubber is the only plantation crop which makes use of leguminous ground covers. This cover crops can mobilise large quantities of plant nutrients, particularly nitrogen during the first two or three years after their establishment in newly planted areas, thereby promoting the performance of the trees in respect of growth and yield. Cover crops will also control soil erosion. Controlling soil erosion is all the more important as most of our rubber is grown on hilly or sloping land exposed to wind and heavy rains resulting in severe erosion of the rich top soil. The covers will also help in reduction or elimination of root disease as found in Malaysia, the greater use of legume covers becomes essential.

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Apart from the changes in the above mentioned factors, changes were experienced in other aspects such as preparation of land for planting, clearing the land for planting, lining, pitting, planting, density of planting etc.

It has been found from the foregoing discussion that the rubber plantation industry in India witnessed significant changes in the technology of production. The most important change being the change in the quality of the planting materials. High yielding planting materials developed in the research centres inside and outside the country were widely used by the farmers. High yielding planting materials with a reduced immaturity period were also developed. The use of high-yielding planting materials were supplemented by improved cultural practices, scientific application of fertilisers and pesticides, rainguarding and use of yield Stimulants. All these factors are said to have helped in improving the production of natural rubber in the country.