EFFECT OF NPK FERTILIZERS ON THE LATEX YIELD OF *HEVEA BRASILIENSIS* MUELL. ARG. IN A RUBBER ESTATE

A thesis submitted for the degree of
DOCTOR OF PHILOSOPHY
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DEDICATED TO MY MOTHER AND LATE FATHER

CERTIFICATE

Certified that the thesis entitled, **"EFFECT OF NPK FERTILIZERS ON THE LATEX YIELD OF *HEVEA BRASILIENSIS* MUELL. ARG. IN A RUBBER ESTATE"** submitted by **A.T.M. Emdad Hossain** in fulfillment of the requirements for the award of the **DEGREE OF DOCTOR OF PHILOSOPHY in Soil Science under the Faculty of Biological Science, University of Dhaka**, is an original research work carried out under our supervision. No part of the thesis has been submitted anywhere for any other degree or diploma.

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CHAPTER 1. INTRODUCTION

INTRODUCTION

As Priestle had foreseen about two and a half centuries ago (FAO 1973), modern civilization still runs over the wheels of rubber. This is particularly because it is an effective alternative to metals and wood in many uses of the present time. In some cases, finding alternative of rubber is almost out of reach of present technology. A lot of industrial and commercial goods necessary in communication, insulation, construction and general domestic consumption are prepared with rubber (Jumpasut 1997).

Of the two types, natural rubber is cheaper, more durable, and more easily obtainable than synthetic rubber. Natural rubber may be obtained from the latex of widely different plant species (Mukhapadhaye *et al.* 1993) but some of those of the genus *Hevea* of the family Euphorbiace are particularly known for their quantity and quality of latex. The most popular natural rubber producing plant is by far the *Hevea brasiliensis* Muell. Arg, a native of Brazil but cultivated widely in many countries and contributing about 99% of natural rubber. It is primarily a tropical perennial tree but has acclimatized in many environmental variations. The principal natural rubber producing countries in the world are Brazil, Cambodia, Cameroon, China, Cote D'Ivoire, Guatemala, India, Indonesia, Malaysia, Nigeria, Philippines, Sri Lanka, Thailand, Vietnam etc. However, management and research in rubber production have long been given priority in Malaysia and India.

Rubber was first planted in Bangladesh on an experimental in 1910. Plantation on commercial basis under the government initiative started during 1960-61. In the National Fourth Five Year Plan of the government proposal to raise rubber plantations to 37000 ha from the present 20,000 ha of land has been advocated. Within the projected area 27,000 ha would be under the public sector and 10,000 ha of under private sector. So far, rubber plantations have been raised in the Govt. reserve land which remains fallow/ unused/under-use or near by hinter land. Management of these plantations and further cultivation lie under the responsibility of Bangladesh Forest Industries Development Corporation (BFIDC), Chittagong Hill Tracts Development Board (CHTDB), private sectors and others. Bangladesh has targeted planting about 40000 hectares of land for rubber within 2010. BFIDC is maintaining about 1.50, 0.35 and 2.50

million of mature, over mature and immature plants respectively. The organizational goal is to achieve around 5500 ton of rubber per year within 2000 (BFIDC 1998). Rubber clones in Bangladesh have mostly been imported from Malaysia, Indonesia, Sri Lanka and even from unknown sources (Anderson and Chalmers 1985, Rahman *et al.* 1988, Nandy 1990). The major clones are TJIR -1, RRIM- 600, PBIG, PB- 235, PB-217 (Turner 1985, Hossain 1983b, Anon 1989, Nandy 1995). Main rubber estates of Bangladesh are Dantmara, Kanchan Nagar, Tarakhon, Dabua, Holudia, Satgaon, Bhatera, Rupaichari, Shahji Bazar, Raozan, Tangail, Madhupur etc. In Bangladesh only 7% of the demand of rubber can be met with estimated current annual production rate of latex (Nandy 1990). The existing rate of production in Bangladesh is only about 500 kg/ha/yr which is very poor according to Malaysian standard (Chan 1975). The poor production capacity may be due to poor management, low tree density and absence of improved variety.

Estimates revealed production of 3.085 million ton natural rubber and 8.06 million ton synthetic rubber in 1981 in the world (RRIM 1989). Within the 20th century the estimated demand of natural rubber should have been 6.07 million ton (Jumpasut 1997). So, due emphasis is being given on increasing natural rubber production. The steps to be taken to enhance production should include tree improvement for higher yield, increasing plantation areas and adopting improved management for better yield per unit area of plantation. Due to increasing population and rubber consumption, more emphasis should be given to enhance production in existing plantations and more areas need to be brought under rubber cultivation in our country.

There have been some works on the soil requirement of the species. Total nutrient (N, P, K and Mg) contents at least of medium levels without deficiency of trace elements, a pH of about 4.5 and absence of saline and acid sulfate conditions have been found to be suitable (Chan 1975). Chan *et al.* (1974) observed that top soil with sandy loam and subsoil with sandy clay loam provide less nutrients than clay soil. They found that foliar nutrient levels were also influenced by the nutrient supply in soil. They further observed that Haplorthox soil has higher productive potential than Sulfic Tropaquepts. Punnoose *et al.* (1975) rated soil fertility as low, medium and high based on NPK values of different concentrations. Available P and K of 1-2.5 me/100g and 5-12.5 me/100g respectively were rated as medium fertile soil. Ranges of 0.50 to 0.75% soil organic carbon, treated as a measure of available N, were considered medium. Hassan (1983) concluded that well drained soils of the high terraces and of the tertiary hills were suitable for cultivation of rubber.

Fertilizer application is one of the plantation management practices for better yield. Extra nutrients are needed during the growth cycle and for improvement of soil fertility. But fertilizers must be used judiciously, that in proper amount and proportion and at proper time (ICAR 1980). For fertilizer application considerations are to be given to the crop/ soil/environment etc. (Potty *et al.*, 1975). Judicious addition of nutrients together with giving the plants the most suitable physical condition is emphasized to sustain productivity of the land and biota (Wong 1988).

The importance of research on fertilizers in rubber has long been recognized. However, fertilizer predictions are not easy for such long rotation crops as rubber. Field trials are not always feasible particularly well ahead of the stage of tapping. RRIM (1963) proposed a general guideline for fertilizer application based on some critical leaf nutrient values of N, P, K and Mg (Sivanadyan 1988). During the last two decades many reports on fertilizer response from mature rubber were published (Pushparajah and Guha 1968). It was earlier believed that fertilizer application is only desirable in the immature phase and it should be ceased while they continue to produce latex (Guha 1975). However, differential responses of rubber to fertilizers and the variations in yield have been found and this could be due to the stage of growth of trees and nature of soils (Pushparajah and Guha 1968, Chan 1971). Plant nutrients in rubber ecosystem are continuously in a dynamic flux. Nutrients in the soil reservoir are changing simultaneously due to removal and addition of the components in rubber ecosystem. Substantial amount of nutrients are removed through plant uptake and immobilization. Jeevaratnam (1969) observed that continuous application of fertilizers may account for at least 40% of the total response in growth and 50-60% for latex yield. Through leaching, volatilization, denitrification, latex removal and soil erosion, some of the nutrients are lost from the soil and should be supplemented in fertilizers (Noor 1988). Noordwijk *et al.* (1997) observed that latex harvest removed considerable amounts of N, P and K from soil. Pushpadas *et al.* (1975) also observed that imbalanced nutrition caused brown bust in rubber trees. They suggested to apply fertilizers based on past manurial history and analytical results of soil, leaf and latex yields. Punnoose *et al.*

(1975) and Omont (1984) also suggested similar recommendations. Yew *et al.* (1980) reported that manuring increased profit by 33% in rubber per ha/yr.

Anam *et al.* (1981) opined that vertical increment of latex production could be achieved through fertilizer application and improving the management of the garden and with inclusion of improved clones in the plantations. Chowdhury (1974) emphasized the need of research on fertilizer application of rubber in Bangladesh. There has been very little work in this regard particularly on mature rubber and in respect of response in latex yield (Hossain 1983a). Caskie (1983) and Mackwin (1987) also suggested application of fertilizers in the plantations of Bangladesh and emphasized the need for soil and plant analyses for fertilizer recommendation.

The production of existing low yielding *H. brasiliensis* under cultivation in Bangladesh needs to boost up substantially (Nandy, 1990). To increase yield through fertilizer application including improved management practice is quick in comparison to introduction of improved species or by tree improvement practices (Pee and Khoo 1975, Zabala 1990). The variability within the soils of rubber growing areas of Bangladesh have not sufficiently been evaluated and recommended of fertilizers for rubber of other countries should not apply without giving consideration to soil conditions. For a sound fertilizer dose and schedule, correlation of soil and leaf analysis data and the effect of added fertilizers on latex production should all be taken into consideration.

With this background and on the fact that improvement of latex yield under existing management systems might have an impact on the extension of rubber cultivation both in the public and the private sectors, the present research work was undertaken to observe effects of added fertilizers to mature plantations at Dantmara Rubber Estate in Chittagong. The main objectives were:

- To evaluate existing soil conditions under rubber plantations,
- To find out litterfall and nutrient returns in rubber plantations,
- To observe foliar nutrient levels before and after fertilizer application,
- To assess the effect of N, P and K fertilizers on latex yield, and
- To examine profitability of fertilizer application in mature rubber plantations.

CHAPTER 2. REVIEW OF LITERATURE

REVIEW OF LITERATURE

Latex, a biological product of rubber trees, contributes significantly towards the development of world civilization. In Bangladesh, rubber cultivation was introduced during the sixties. At present there are approximately 20,000 ha of plantation of which only 2000 ha are under production of latex. The latex production per unit land area of the existing plantations is not satisfactory. Therefore, it has become a burning need to evolve measures to increase production capacity in Bangladesh. More than 50 rubber producing countries are trying to boost up the production through application of fertilizers. In the following sections, available information has been reviewed to assess the present status and to indicate the future need of research in the field of rubber fertilization.

2. 1. Rubber Producing Plants

In the ninetieth century progress in finding and developing new sources of rubber was more rapid than the previous time. Clouth (1903) stated that there were about 400 known rubber-bearing plants. By this time about 900 genera and 12500 species of latex producing plants have been identified. These species belong to the families Euphorbiaceae, Moraceae, Apocynaceae, Compositae, etc. (Mukhapadhaye *et al.* 1993). The genus *Hevea* is particularly known for latex producing potentialities. *H. brasiliensis*, *H. benthamina* and *H. guianensis* produce commercially acceptable latex (Nandy 1990).

H. brasiliensis, a perennial tree, contributes a physiological product-latex (raw rubber), known as Para Rubber/Brazilian Rubber, as the harvest (Punnoose *et al.* 1975, Devakumar 1988). Para rubber contributes almost 95% of the total rubber. It is a hardy, moderately quick growing tree of the tropical regions and belongs to the family Euphorbiaceae (Khisa 1991).

2. 2. Natural Rubber vs. Synthetic Rubber

Latex of *Hevea* is a hydrosol which contains rubber (Gomez and Hamzah 1989). It is a natural polymer compound with the chemical formula $(C_3H_8)n$ and is known as 1, 4, Polyisoprin. Latex contributes 22-48% solid contents, excluding watery substances. It contains about 2% resin, 1.5% protein, 1% starch and 0.5% inorganic substances (Khisa 1991). RRII (1995) studied latex diagnosis parameters like P, Cr, total solid content (TSC), thiol, inorganic phosphate and sucrose. These were analyzed in wet season (July) and dry season (February) for six clones. It has been found that Cr, TSC and thiol were higher in dry season compared to wet season.

Exploration of constituents in natural rubber contributed to preparation of synthetic rubber. The chemical formula of the synthetic rubber is $(CH_2\text{-}CH{=}CH\text{-}CH_2)n$ which is known as polybertadiene rubber. Synthetic rubber is less elastic and durable than natural rubber. Malaysia tops the list in natural rubber production whilst USA in synthetic rubber. A statistical report showed that production and use of natural rubber (3.085 MT in 1981) is less than synthetic rubber (8.06 MT in 1981) in the world (RRIM, 1989). The estimated demand of natural rubber would reach 6.07 MT within the 20th century and a recent evaluation (Appendix I and II) showed that the demand of natural and synthetic rubber would be higher than the previous (Jumpasut 1997). So, more emphasis is given on natural rubber for production in future. Figure 2.1 shows the distribution of synthetic and natural rubber producing zones.

2. 3. Utilization of Rubber Tree Products

Rubber plants are no less important than other forest crops. In addition to its latex, wood, seeds etc. are used for various purposes. A study on physical properties of rubber wood showed that it's timber is suitable for making furniture and categorized as B-grade timber, i.e. next to teak (Sattar *et al.* 1991).

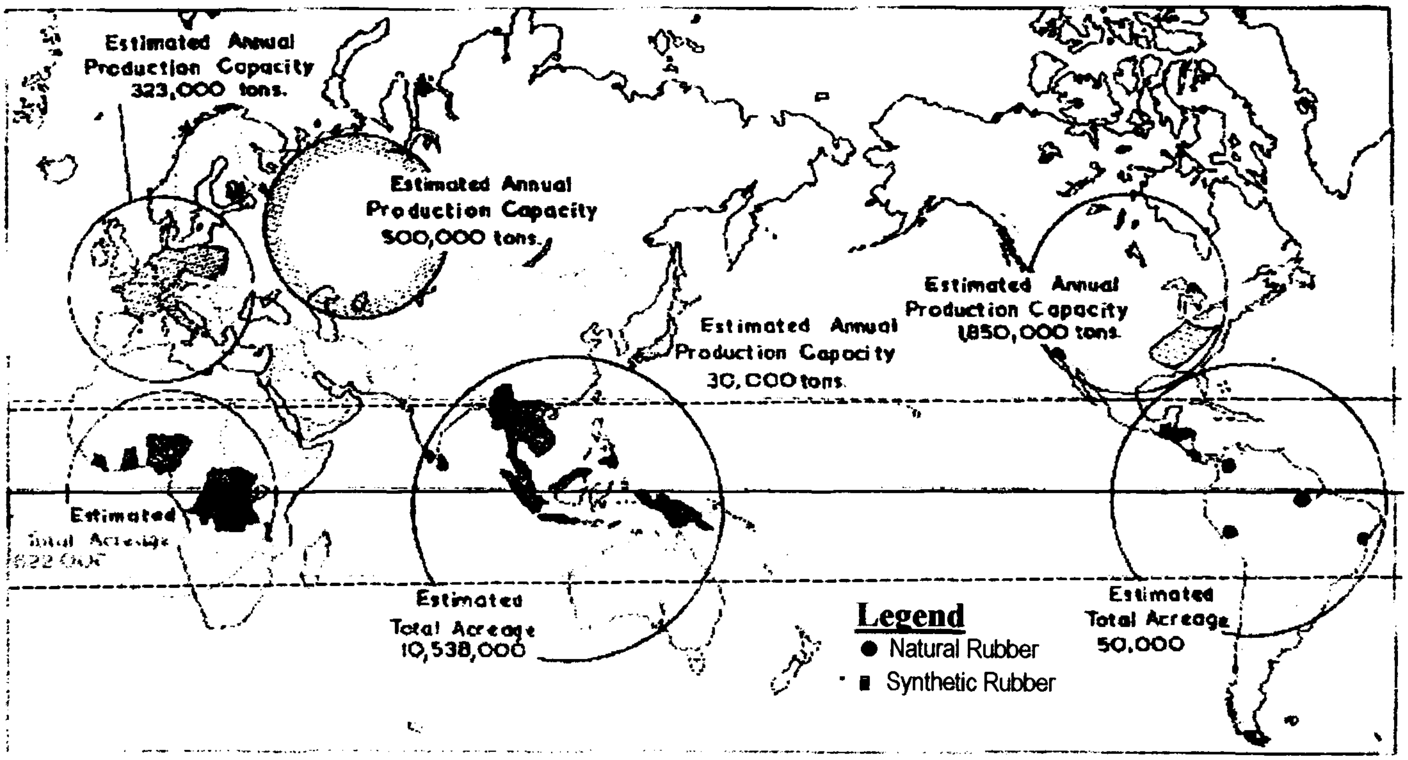

Fig. 2.1 Distribution of natural and synthetic rubber producing areas in the world (Polhamus 1962)

It is suitable for furniture and particleboard at a less cost (30 to 50% less) than champa, chikrashi, chapalish etc. (BFIDC 1996). Peck's (1957) study on shrinkage and swelling of rubber wood, Choon and Bin's (1982) findings of chemical composition and the results of Das *et al.* (1995) on cellulose content and water repellent property suggest that the species seems to be suitable for chemical pulping, conversion products and various indoor uses.

RRII (1992) reported that the branch wood, about 40% of the total rubber wood, could be used as firewood in the domestic sector and in the rubber factory. Stem wood may be consumed in various industrial uses. Rubber seed contained oil which was about 12 to 16% of the total seed weight under commercial condition. Rubber seed oil is mostly used for manufacturing inferior quality washing soaps. A small quantity is used in paint, varnish and leather tanning industries. Seed cakes are also produced in India. There, rubber plantation is also a prolific producer of honey. Majumder (1992) reported that even the rubber factory effluent, a highly polluting substance, may be used as liquid fertilizer in rubber plantation after 60 days of pounding for microbial alteration.

2. 4. Socio-Economic and Environmental Effect

Deforestation and degradation of natural forests have become increasingly faster during last two centuries because of increasing population pressure (Awang 1995). Severe deforestation estimated to be about 15.4 M ha/yr has been recorded within 1981-90, which is significantly greater than the depletion (0.8%) between 1971 and 1980 amounting to about 11.4 M ha. The loss was most pronounced in Bangladesh, Pakistan, the Philippines and Thailand (FAO 1993). To combat this situation, reforestation and afforestation have been getting priorities now-a-days for environmental conservation. Rubber plantations may serve as forests and at the same time give continuous returns in the form of latex (Majumder 1992).

It is also reported that rubber plantation creates considerable employment opportunity. At present, about 25000 manpower are employed in the Rubber Sector of Bangladesh. According to Anon (1989) rubber provides similar return to funds in comparison to forestry, with five times more employment/ha. In addition, it can contribute more to the environment by converting CO_2 to carbon polymer compounds.

2. 5. Ecological Suitability

H. brasiliensis is a tropical crop which grows within 1000 km to the north and south of the equator and survives in areas up to 330 m above MSL (Khisa 1991). Optimum ecological requirements for growing the species are evenly distributed annual rainfall of 2000 mm over the year, temperature of 21-25°C and well-drained loamy soil. However, prolonged drought for more than two months is not convenient for growing the species (ICAR 1980).

2. 5. 1. Land

Land suitability (actual and potential) is the fitness of a particular land unit for a definite use under a set of management conditions (Sinthurahat 1985). Pushparajah *et al.* (1974) evaluated the need for economic consideration in allocation of land for rubber cultivation. Not only the yield but also the cost of production depends on the category of soil. Upgrading the previous system Sys (1978, 1980) evaluated the suitability for rubber cultivation based on FAO's Framework (1976). He further classified the limiting factors for its growth. He obtained the land indices by multiplying the scores, ranging from 0-100%, against the diagnostic criteria like soil depth, slope gradient, texture, soil fertility, etc. Yew (1982), incorporating climatic factor into the FAO's land evaluation system, contributed a total concept towards the achievement. Yew (1988) suggested to consider both the physico-chemical and physiographical condition for rubber cultivation. He further suggested to select clones for a particular area on the basis of its adaptability to a particular environment.

Loyad (1959) found that the edaphic and climatic conditions of Bangladesh are suitable for rubber cultivation. Based on FAO's Framework (1976), Hassan (1982) evaluated the land suitability for cultivation of rubber in Bangladesh. He indicated that the shallow and deeply weathered brown terrace soils are very suitable and Brown Hill Soils are marginally to very suitable for rubber cultivation. After land suitability assessment Richards and Hassan (1989) reported that 630678, 846044 and 643475 hectares of terrace and hilly land are respectively highly, moderately and marginally suitable for rubber cultivation in Bangladesh. Typic Paleudults (TP) and Tropic Haplorthox (TH) satisfy the soil requirement of rubber tree growth while Typic Sulfaquepts (TS) and Typic Tropaquepts (TT) have some limitations. TP and TH soils gave the highest yield where as TT and TS soils produced the lowest yield of rubber. Besides, pedological properties of Oxic Dystropepts are considered to be intermediate in respect of yield. These groups fall in the Order Inceptisols, Ultisols and Oxisols (Chan 1975).

2. 5. 2. Climate

The agro-climatic factors play significant role in rubber production (Narayanan 1967). Of all the factors, rainfall has a dominant effect on the following: planting season, successful establishment, growth and management of plant, including specially latex tapping, as it continues all the year round (Gibb *et al.* 1984). Total amount of rainfall is not as important as intensity of rain. It was shown that 3 or 4 days' rain/month above 2.5 cm per day could account for more than 50% of the total loss of N and K fertilizer. Similarly, temperature is an important factor annexed with biophysical and biochemical activity (Brady 1995).

Haridas and Subramaniam (1985) observed that higher number of rainy days decreased yield. The rainfall of 10-11 mm per day was congenial to higher yields and a curvilinear relationship with the increase in number of rainy days was observed. It was noticed that 15.5 mm rain per day interfered with tapping. They found a non-significant correlation between moisture storage in soil and latex yields. Further they found a correlation with mean yield (g/tree/tap) and rainy days. They also observed a positive correlation with rainfall intensity and found the best yield of latex within 10-11mm rain/day.

Barlow and Carrad (1975) showed that high rainfall means frequent interference with tapping. They experienced that there were usually around 250 tapping days; and more than 300 tapping days a year is rare. Martinez and Pinheiro (1977) estimated 130 tapping days in a year in Brazil. Sachuthananthvale (1975) observed that in Sri Lanka, 70 tapping days or more a year were lost due to rainfall, which influenced 30% of the potential latex yield loss. He also reported that approximately 60% of the yield loss caused by rainfall is coverable by the use of rainguards to protect the tapping panel.

Gan (1988) cited an example of rainfall interference with tapping of rubber. He found that rain interfered 47 days out of 119 rainy days with tapping, which caused no tapping on about 22 days, late tapping on 15 days and wash out on 10 days. He further observed that late tapping resulted in 9-20% loss of rubber yield. On wash out days the loss was 74% when it rained 1 (one) hour after tapping but 30% if after 3 (three) hours. The overall annual loss of latex yield was estimated at about 360 kg/ha.

Daud *et al.* (1989) evaluated that the wettest months, the most rain interfering period, is the highest latex yielding time, as well as loss of latex is substantial. Haridas and Subramanian (1985) found that high moisture storage in the soil was not related to higher latex yield during rains and that was attributed to loss in tapping days during rainy spells.

Wen and Chen (1982) did an analysis of chilling injury indices on rubber trees. They found that the minimum temperature was the main factor responsible for such injury. The injury was slight at about −1.0°C, moderate in between −1.0°C and 2.2°C and severe above 2.2°C. It was found that occasionally cold currents from the north affect southern China and causes chilling injury to *Hevea* metabolism. Carbohydrate breakdown and NP metabolism are enhanced and toxic compounds such as ammonia are accumulated due to low temperature and if it prolongs (Wang *et al.* 1978). However, chilling injury in plants is unlikely to happen in Bangladesh.

It was recognized that the yield of most clones increased in successive years. Kulil-Filho *et al.* (1982) found that with the increasing age there was a tendency of a clone to show significant differences between months but only in 2 years clone × months interaction was significant. The climatic variation causes interference in clone × year interaction significantly. Biot *et al.* (1984) evaluated the climatic index by multiplying the ratings of the drought season (rainfall less than half of potential crop evapotranspiration) and (PRE-PE) × crop coefficient (Ke), which is equal to 1.01 for rubber. The loss of tapping days is deduced from the number of rainy days (loss of tapping days = rainy days/2).

The rainfall distribution pattern is the major climatic factor that influences land suitability for rubber cultivation in a particular site (Sinthurahat 1985). Biot *et al.* (1984)

concluded that the factors temperature, annual rainfall and rate of tapping days do not show significant variation in latex production. Arakeri (1962) found that rubber productivity varied with function of the rainfall distribution and the evaporation. Numuta (1987) expressed that high temperature and humidity requirement is common characteristics of plants growing in the monsoon areas of South East Asia. RRII (1995) established a correlation between environmental parameters viz. maximum temperature and soil moisture.

In Bangladesh the potential evaporation is more than precipitation during the months of November to May (Rashid, 1991). Plants are supposed to suffer from drought during these months unless mitigated by the soil water reserves, dew fall and plant adaptation (Osman 1996). The yearly temperature of 21-25°C and rainfall of 1778-3810 mm respectively is suitable for rubber cultivation (Khisa 1991). Based on Manalo's (1975) meteorological data and Thornwaite's classification system (1948), Hassan (1982) suggested that the climatic condition of Bangladesh was suitable for rubber cultivation.

2. 6. Rubber Cultivation in Bangladesh

Emergence of Bangladesh as a rubber producing country dates back nearly 40 years. It was reported that a few rubber trees (*Hevea brasiliensis*) were planted around 1910 at Baramashia Tea Garden of Chittagong and Amu of Sylhet District (Ali 1985). During 1954-55, the Forest Department planted some rubber seedlings on experimental basis in Madhupur, Tangail and Mithapukur, Rangpur. The experimental results were satisfactory (BFIDC 1995, Ali 1985).

The original scheme for rubber planting project was initiated by the Forest Department, during 1960-61, which was subsequently revised several times. Ultimately the rubber project was handed over to the BFIDC in 1972 (Chowdhury 1974). During that period the first rubber plantations were raised at Ramu and Raojan respectively in 12.15 ha and 4.66 ha area. It is observed as per record that during 1960-61 to 1979-80 about 5314 ha of rubber plantation were raised in the four Estates of Chittagong and other four Estates of Sylhet (BFIDC 1993).

In Bangladesh estimated annual demand of natural rubber at present is 2.5 thousand tons. This demand is expected to grow by 10% annually. With the current rate of latex tapped, only 7% of the demand can be met. The rest is imported (Nandy 1990). The existing rate of rubber production in Bangladesh is about 500 kg/ha/yr which is very poor in comparison to Malaysian Standard (Chan 1975).

In view of achieving national objectives, the Government issued policy directives in August 1977. It was indicated that rubber plantation should be raised to 16,000 ha under public sector. The scheme for "Expanded Rubber Plantation and Processing" was drawn up in 1980. That was the First Rubber Planting Project in Bangladesh (Nandy 1990, BFIDC 1993). The objectives of the project were to rehabilitate about 5,000 ha of existing plantation and to raise additional 5,000 ha of new plantation in Chittagong and Sylhet regions by 1983-87. Anon. (1989) studied the feasibility of the "Second Rubber Development Project" during 1988-89, considering the potentialities of rubber production. It was proposed to expand rubber cultivation in suitable parts of Chittagong, Chittagong Hill Tracts, Tangail and Comilla (Nandy 1990). The approximate locations of rubber growing areas of Bangladesh are shown in the map (Fig. 2 .2).

During 1980-81 to 1986-87 ADB funded for maintaining the old plantations and raising of about 1,000 ha in the new plantations in 7 Estates of Chittagong and 4 of Sylhet. About 7845 ha land of that area was planted by high yielding varieties (BFIDC 1995). Rubber plantation at about 6073 ha was taken in hand during 1986-87 (Phase II), in the Madhupur Rubber Estate and is expected to be completed soon.

There has been a proposal of raising rubber plantations to 37,000 ha from the present 20,000 ha in the Fourth Five Year Plan. Of the total area 27,000 ha will be under the public sector and 10,000 ha will be under the private sector. During the FFYP, another 11,000 ha of plantation is expected to be raised under the public sector in Chittagong, Cox's Bazar and Madhupur areas. The total raw rubber production during the terminal year of FFYP is targeted at 7,000 MT from that of present production of 1,200 MT.

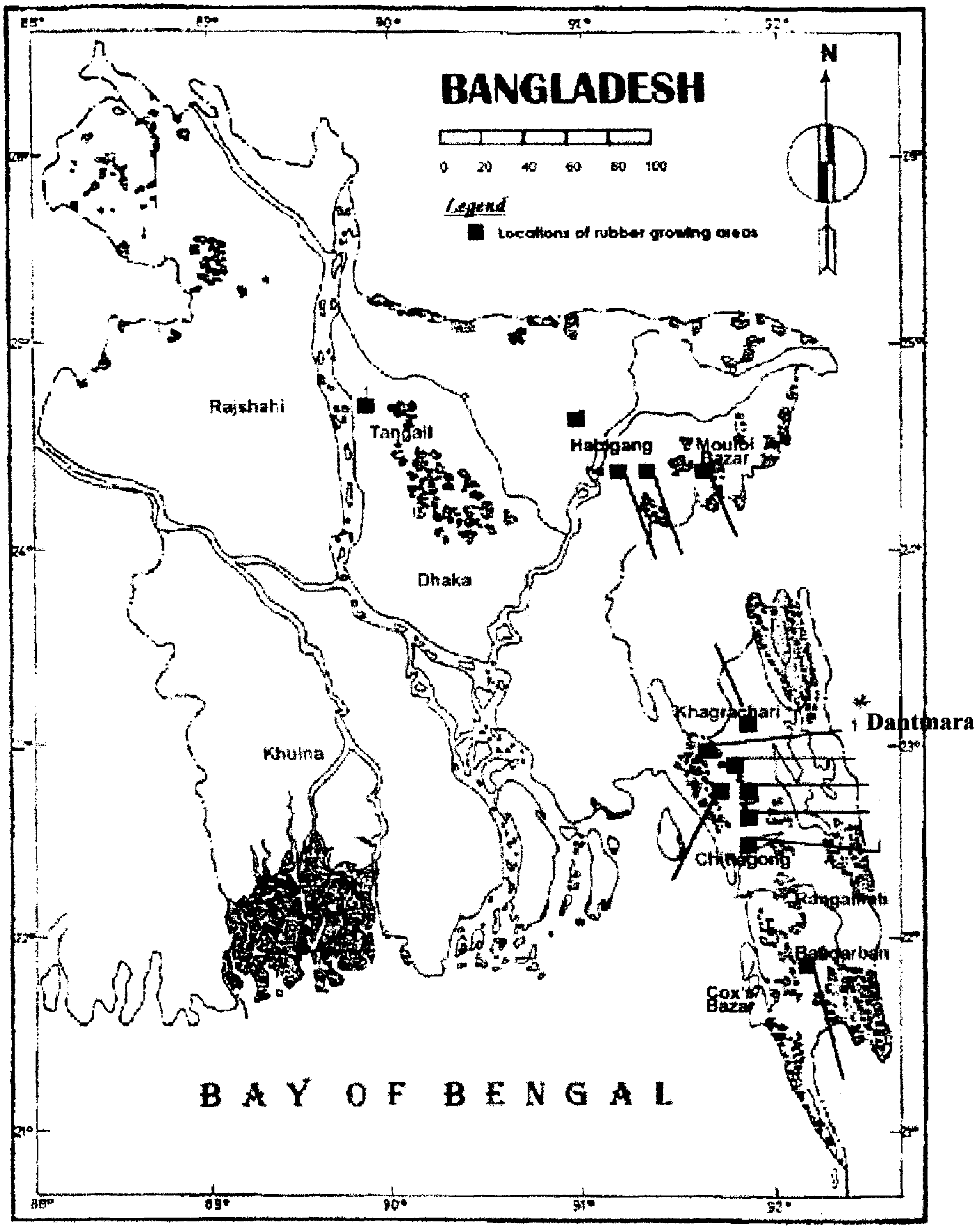

Fig. 2.2 Rubber growing areas in Bangladesh

It is expected that this production would be sufficient to meet 40% of the nation's annual raw rubber demand. The commission further proposed that BFIDC would be responsible for raising rubber plantations in the public sector. Despite of that, a study would be undertaken to explore the possibility of privatization of the individual BFIDC rubber estates (BFIDC 1995).

The chief objectives of rubber projects of BFIDC are as follows:

- To utilize barren, fallow, deforested lands and available agricultural lands to produce natural rubber for attaining self-sufficiency in production.
- To create opportunities for feeding the rubber industries by supplying the local produce.
- To save scarce foreign exchange by substituting import of both raw natural rubber and finished rubber products.
- To generate employment opportunity in rural/ forest areas, and
- To conserve environment, that is to reduce soil erosion and to control flood etc. indirectly.

2. 6. 1. Existing clones in Bangladesh

Most of the clones of rubber in Bangladesh have been imported from Malaysia, some from Indonesia and Cylon (Rahman *et al.* 1988, Nandy 1990), and even from unknown sources (Anderson and Chalmers 1985). A possible detailed account on the planted rubber clones of Bangladesh is presented in the Appendix-III. The estimated planted area in BFIDC by the clones, TJIR, RRIM-600 and PBIG are 30%, >32%, >16% respectively. These three are of RRIM clones with wider genetic base (Yeang *et al.* 1998). Among the planted clones RRIM-600 and PB-235 were found to perform satisfactorily in Bangladesh(Turner 1985).

Guha (1992) reported a number of planted clones used for rubber plantations in unclassed state forests of Chittagong Hill Tracts Development Board. These include TJIR, RRIM-600, PB-217, PB-255, PB-260, PBIG 5/6, GT-1, etc. Hossain (1983b) gave an outline on some Malaysian clones planted in the rubber estates of BFIDC during 1960-78. He cited that according to Malaysian scientists RRIM-600, PB-255, PB-217 and GT-1 would be the most suitable clones for Bangladesh. Anon. (1989) suggested to plant wind resistant clones PB 5/51, PB 217 and PB 255 in the coastal areas rather than RRIM 600 or PB 235. They further urged to make windbreaks if the latter clones are planted.

2. 6. 2. Present management in mature plantation

Mature plant population (280/ha on an average) in Bangladesh is less than that in other countries. In Malaysia average density ranges from 280-400 plants/ha (Chan, 1975). Leguminous cover crops, which may contribute to improve the soil, are not well maintained in plantations of Bangladesh (Khisa and Hossain, 1993). Management of weed and amelioration of soil are not adequate. There is also lack of proper management in latex extraction and collection (Anam, 1981). There is limitation of manpower management and labour efficiency development in the Rubber Estates of Bangladesh (Kashem, 1985).

The survival percentage of rubber was found to be 110 plant /ha in the estates of Eastern Region of Bangladesh before taking rehabilitation programme. The sudden fall of tree density may be associated with cyclone damage in 1991 (Mazumder 1996) and some other reasons like fire incidence, liberation war etc. (Nandy 1995). A massive rehabilitation programme was initiated in 1993 and the present survival of trees after rehabilitation has been found about 251 ± 13 per/ha (Appendix IV). However, the real survival of rehabilitated trees would appear after few years.

2. 6. 3. Latex production

Nandy (1995) found that the average collection of latex per hectare was 2063 kg in Dantmara, 1747 kg in Kanchan Nagar, 1308 kg in Tarakhon, 2739 kg in Dabua, 1335 kg in Holudia and 3217 kg in Raozan Rubber Estate. Latex is collected at present from

24% of total planted area of Dantmara, 18% of Kanchan Nagar, 22% of Tarakhon, 20% of Dabua, 29% of Holudia and 33% of Raozan Rubber Estate. However, the real production potential that has been shown for each estate (Appendix V) can be achieved through extensive and successful rehabilitation programme and their scientific management.

2. 6. 4. Fertilizer effects on rubber in Bangladesh

Many scientists suggested fertilizer application in rubber plantations from the time of planting up to latex collection (ICAR 1980). In Bangladesh the need of research on that field has also been recognized by management personnel, consultants and others (Chowdhury 1974, Caskie 1983, McEwen 1987). Some scattered works have been done on nutrient elements of soils and leaf in different rubber plantations of BFIDC (Zaman *et al.* 1984; Osman *et al.* 1988; Shamsuddin *et al.* 1990, Hossain *et al.* 1992, Gafur and Zaman 1993).

McEwen (1987) recommended application of 100g urea, 200g TSP and 150-200g MP per tree/year in rubber plantations of Bangladesh. BFIDC (1989) modified the dozes of McKwen (1987) and proposed 57 to 85g urea, 85 to 113g TSP and 57 to 85g MP per tree thrice in a year. These workers emphasized to undertake systematic research on the effects of fertilizers on the growth and production in rubber plantations in Bangladesh.

2. 7. Studies on Soil Properties and Nutrition of Rubber

2. 7. 1. Soil and leaf analysis

Soil-plant relationship can be established through analyses of soils and plants (Black 1968). Chemical analysis of soil can provide only an approximation of the available nutrient elements. The uptake of the available nutrients of soil by plants may be reflected in plant tissues, for example foliage. Research findings of the last four decades showed that plant tissue or foliar analyses involve remarkable complication (Leaf 1973). Specially the complication arises when variation of leaf nutrient content occurs due to different reasons which make interpretation difficult (Lu and He 1982). Works of Shorrocks (1962), Guha and Narayanan (1969), and Pushparajah and Tan (1972) have provided considerable data in this field. Sivanadyan (1980) concluded that the leaf analysis is a suitable diagnostic indicator over bark or other tissue.

2. 7. 2. Studies on soil

Silva (1971) found that soil samples of 0-15 cm and 15-45 cm depths were suitable for assessing its fertility status. Pushparajah *et al.* (1975) studied soils of a long term fertilizer trial on mature rubber trees, from depths of 0-15, 15-30 and 30-45 cm. They suggested to collect samples after one year of last application of fertilizers while Lau (1975) recommended sampling after ten months of the last fertilizer application.

Heng and Yin (1989) studied sampling procedures for the collected composite soil study in rubber plantations. Their findings suggested that one composite sample from 10 random points over 15 ha area would be adequate for the determination of soil pH, organic carbon and nitrogen for assessing the fertility level.

Soils information for proposed planting area /or soils under plantation provide a vital role for proper and efficient agro- management inputs. It was found in extensive studies (Noordin *et al.* 1977, Noordin *et al.* 1985) that rubber is planted on a wide range of soil types. Rubber was very extensively planted on Ultisols and Oxisols, rather extensively on Inceptisols and less extensively on the Entisols and Histosols in Malaysia (Noordin 1988).

Yew (1988) stated desirable physical, chemical and physiographic characteristics of soils for rubber cultivation. He mentioned some degree of limitations and evaluated suitability classes. The desirable criteria for rubber cultivation are as follows:

The soil must be free of iron pan/rock outcrop down to the depth of 100 cm. Well - drained soil, good aeration, good water holding capacity, no peat or acid peat deeper than 20 cm, soil texture preferably 35% clay to retain sufficient moisture and nutrients and 30% sand to allow good aeration and drainage etc. are desired for establishing the plantation. Desirable physiographic features are gentle sloping or rolling terrain between 2-9° gradient (4-20% slope) with minimal soil erosion and surface run-off; water table should be deeper than one meter at all seasons and should be free from saline or acid sulfate conditions.

Chan *et al.* (1974) observed that top soil with sandy loam and subsoil with sandy clay loam provide less nutrient than clay soil. They found N, P, K and Mg contents in leaf in loamy soil as 2.97%, 0.19-0.22%, 1.50 % and 0.29 % respectively. All the nutrients except Mg were higher in clay soil. They further observed that Haplorthox soil has higher production potential than Sulfic Tropaquepts. Punnoose *et al.* (1975) rated soil fertility as low, medium and high based on N, P and K values of different concentrations. Available P and K of 1-2.5 me/100g and 5-12.5 me/100g respectively were rated as medium fertile soil. Organic carbon content (a measure of available N) between 0.5 and 0.75% was considered medium. Studies on some rubber growing soils of Bangladesh (Zaman *et al.* 1984, Osman *et al.* 1988, and Rahman *et al.* 1990) reveal that these are mostly Typic Hapludults (Rangapani series, Rumu Estate); Humic Paleudults (Ramgarh series, Raojan,Tarakhoan and Dantmara Estate), Typic Hapludults (Dabua and Holudia of Rangamati series) and Typic Dystrocrepts (Nalua series, Kanchan Nagar Estate) which are poor to medium in fertility. However, Hassan (1983) evaluated the land suitability for rubber cultivation in the upland soils of Bangladesh. He reported that well drained soils of the high Terraces and of the Tertiary hills were suitable for rubber cultivation.

2. 7. 3. Studies on foliar nutrients

The leaf nutrient levels are influenced by a number of factors, e.g. leaf position, rootstock, scion, crown, time of sampling, seasonal effects etc. These factors should be considered at the time of interpretation of leaf analysis data (Sivanadyan 1980).

Noor (1988) found that generally higher levels of nutrients are observed in leaves of the shaded canopy, because of their greater sensitivity to nutritional changes than leaves in open light. To minimize the variations in nutrient levels due to leaf position, he suggested collecting the leaves in shade of the canopy from a terminal whorl of a spur of branched mature tree during sampling.

Shorrocks (1964) observed those leaf nutrient concentration changes with leaf age. He suggested the leaf sampling of similar age and the critical age of leaf should be 100 days after fertilizer application. Sivanadyan (1980) found small variation in leaf nutrient levels when sampled at various times of the day. To minimize sampling error he suggested to sample leaf until early afternoon. He further concluded that the time lag between fertilizer application and sampling would influence the nutrient status and uptake of applied fertilizers in mature plantations. Considering the fact, he recommended sampling of leaf in mature rubber at least 70 days after fertilizer application. Bataglia *et al* (1988) assessed the leaf and soil samples from the 40 rubber plantations. in the Atlantic Coastal belt. Afterwards they concluded that leaf N and K concentration were associated with production of latex.

Heng and Yin (1989) collected 12 leaflets per rubber tree (RIMM-600) at 4 intensities, i.e. composite leaflets of 15, 30, 45 or 60 trees; in the area of variable rainfall, topography and plot size. Analytical results showed no significant difference in the nutrient (N, P, K, Ca, Mg, and Mn) composition of laminas and petioles at different intensities. Their findings suggested that composite samples of 15 trees were adequate. Lau *et al.* (1990) suggested to collect composite leaf sample consisting of 4 basal leaves (3 leaf lets/leaf) of a terminal whorl consisting of the low shaded leaves of 30 randomly selected trees for 15-20 ha area.

Tan (1975) considered sixteen mature uniform trees and divided into 4 randomized groups, each in assessing the seasonal changes in the concentration of leaf nutrients in mature *Hevea*. He obtained satisfactory results from his modified approach taking only the central leaflet from each of the 4 basal leaves. If the central leaflet was not suitable, one of the other leaflets within the same whorl that constitutes $(4\times30)=120$ leaflets was considered. Both the samples were processed properly and nutrient composition was determined, which showed that the modified method was comparable to the previous one.

Keli and Omont (1990) collected and analyzed leaf samples of *H. brasiliensis* on a monthly basis. They found that N, P and K contents decreased and Ca contents increased with physiological age. Guha and Narayanan (1969) reported almost similar results. Tan (1975) quantified the leaf weight of mature tree (1 ton/ha) and found depletion of 10 kg N and 5 kg K during three weeks before leaf fall.

Lu and He (1982) found from more than ten years of experimentation, that the least fluctuation in nutrient content occurred in shaded leaves between July and September. They recommended that period for sampling and suggested 3.2-3.4% N, 0.21-0.23% P, 0.90-1.10% K, 0.60-1.00% Ca and 0.35-0.45% Mg as the critical nutrient values for healthy latex yielding trees. They found 10-20% increase in latex yield when fertilized on that basis of foliar analyses.

Punnoose *et al.* (1975) reported the critical leaf nutrient contents of *Hevea*. According to the standard, <3.0% of N is low, 3.0-3.20% as medium and >3.2% as high. Similarly, <0.25% P is considered as low, 0.2-0.25% as medium and >0.25% as high. In case of K, <1.0 is considered as low, 1.0-1.2% as medium and >1.2% as high. Wong (1988) reported the range of leaf nutrient content at optimum age in the shaded canopy for different clones. He classified the concentration of N, P, K, Mg and Mn as low, medium high and very high for some the specified species. There low to high range were <3.3-3.91% for N, 0.19-0.28% for P, 1.35-1.86% for K and 0.19-0.30% for Mg and 45 -151 ppm for Mn in RRIM-600 and GT-1 clones. RRIM (1963) standardized N, P, K and Mg levels, below or above which response of fertilizer was likely or no response under exposed and shaded leaves. It was mentioned that leaf N concentration varied between 3.20% and 3.30% under exposed sunlight and 3.60-3.70 % under shaded canopy condition. In first case response of N is likely but no response in the second condition. Similarly, K response is likely when its range is 1.0-1.30% in leaves of sunlight and there would be no response while concentration remains 1.40-1.50% in shaded conditions. In case of P, response is likely at 0.19-0.21% in exposed leaf, while there might be no response at 0.25-0.27% under shaded condition. In 110 plantations of China, Wang (1987) found that Mn contents in rubber leaf ranged from 31-2167 ppm. He marked that rubber leaf normally contains 150-330 ppm of Mn but the quantity varied remarkably with soil type. He also noted the symptom of leaf yellowing due to Mn deficiency in rubber trees.

McEwen (1987) reported the leaf nutrient values of some of the rubber Estates of Bangladesh. He determined the concentration of N, P, K, Mg and Ca values of the samples of lighted and shaded conditions and graded the values as high, medium, low and very low. Leaf N values of 3.50%, 3.20-3.50%, 2.90-3.20% and 2.60-2.90% were high, medium, low and very low respectively for shaded. P values of 0.22%, 0.20-0.22%, 0.18-0.20 % and 0.15-0.18% were of the respective ranges as mentioned above. In case of K the values were considered 1.40%, 1.20-1.40%, 1.00-1.20% and 0.80-1.00% respectively as high, medium, low range and very low. He found Mg ranges of 0.24%, 0.21-0.24%, 0.18-0.21% and 0.15-0.18% for high, medium, low range and very low. All these contents were slightly higher than the expected values in exposed leaves. In Malaysia, Indonesia, and Africa, the Ca values were 0.60-0.80%, 0.90-1.20%, 0.40% respectively and in Bangladesh it may apparently be about 1.10%.

Pushpadas and Krishnakumari (1973) studied effect of N, P and K fertilizers on soil and leaf. They concluded that application of fertilizers had no effect on N, P, K, Ca and Mg concentration of leaf. There was no correlation with these nutrients in soil and leaf.

2. 8. Fertilizer Effect on Mature Rubber Plantation

Constable (1953) studied long term effect of manuring + NPK fertilizers in Sri Lanka on clonal rubber in immature phase and found a significant yield response over eight years of tapping. He experienced that continuous application of fertilizers may account for at least 40% of the total response in growth and 50-60% of the total response for latex yield. He concluded that the response to applied fertilizers during the production phase is not as beneficial as the response resulting from continued application i.e., from immature phase.

Omont (1984) reviewed the nutritional requirements of rubber at various stages of development. It was suggested that a manuring policy would be based on soil characteristics and the age of trees. He further inferred that, recommendation for mature rubber tree fertilization should be based on assessment of growth, yield and leaf nutrients. Alika (1981), during the yield variation study of 9-13 years old trees over an 11 month period, found that larger plot sizes with fewer replications are necessary to determine treatment differences in field trials. Pushpadas *et al.* (1975) observed that imbalanced nutrition caused brown bast in rubber. So, he emphasized on past manurial history of plantation and analyses of soil, leaf and latex samples. Potty *et al.* (1975) after long experimentation with NPK fertilizers in rubber at different soil regions of India concluded that fertilizer effect was closely related to soil nutrient availability. They further inferred that reasonable prediction could be made on the basis of soil analyses and dose recommendation should be on regional basis.

In trials on a low fertility latosol the mature latex yielding trees showed a marked response to added N and K but not to P, while optimum urea and potassium chloride rates were 533g and 180g/tree respectively (Angkapradipta, *et al.* 1986). Reis *et al.* (1986) applied 60 kg N, 90 kg P and 60 kg K/ha/yr and observed positive yield response to added P. A study on the effect of major nutrients on the physiology of latex production showed that latex yield is increased by K. Potassium addition also enhanced calcium mobility. Moreover, invertase, a regulator of glycolysis is activated by K and its higher activities are found at high pH (Samaraweera 1984). It was also noticed that K had a positive effect on transportation of sucrose, the component of carbohydrate, which is the precursor of latex.

Yogaratnam and Weerasuriya (1984) observed that application of urea at the rate of 210 g/tree/yr and K_2O of 190 g/tree/yr increased yield in some sites. Application of rock phosphate at the rate of 100 g/tree/yr did not always showed beneficial effect, while magnesium application at 42 g/tree/yr had a depressing effect on yield.

Gopalasundarm and Yusuf (1989) reviewed the long-term effect of fertilizers on mature rubber with cover crops grown in the coastal humid soils of South India. They inferred that fertilizer application generally enhanced available P and K contents of soil, whereas available N was seldom affected.

A long-term (14 years) study, conducted by Pushpadas *et al.* (1974) on the effect of ammonium sulfate/nitrate (68 kg/ha/yr), rock phosphate and muriate of potash (90 kg/ha/yr) showed that N fertilizers lowered the soil pH and available K, Ca and Mg. They further observed that P fertilizers raised soil pH and available P, Mg and Ca. Similarly pH and available K were also raised by K fertilization. They also found that leaf nutrient contents (N, P, K, Ca and Mg) were not affected by N, P and K fertilizer application. Soil fertility in unfertilized control plots was medium to high in relation to Indian and Malaysian standards.

Pushparajah *et al.* (1977) observed that tree girth, latex yield and leaf P as well as Ca contents were increased by residual P. The effect was more pronounced in surface soils down to a depth of 7.5 cm. Deying (1983) found K limitation in some parts of China. He obtained a beneficial effect from applied K fertilizers and further suggested that maintenance of N-K balance was important. In a 4 year study on the effect of NPK fertilizers on mature rubber clone GT in a yellowish brown podzolic soil, latex yield was not found to be affected significantly by fertilizer application (Adiwiganda 1979). Moreover, application of 126g and 252g urea/tree reduced yield by 3% and 6% respectively at the 4th year compared to no N fertilizer. After 4 years of experiment in rubber plantation in acidic soil with low P and very low N and K showed that growth and yield response to K were remarkable but the yield response to N was significant in the second year (Angkapradipta 1976). However, neither yield nor growth was affected by P application. Angkapradipta (1976) recommended to apply NK and NPK fertilizers at the rate of 240g N, 162g P_2O_5 and 360g K_2O respectively per tree in every alternate year.

In Nigeria, a 3 year field experiment showed that N, K and Mg fertilizers increased yield of rubber but P fertilizers had no positive effect. Application of 500 g ammonium sulfate, 500 g muriate of potash and 250 g magnesium sulfate/tree/yr respectively increased the annual yield of rubber by 11%, 3% and 9% (Onuwaje 1983).

Reis and Rosand (1988) studied the effect of N, P_2O_5 and K_2O fertilizer application respectively at the rate of 60, 90 and 60 kg/ha/yr during pre- and post-tapping periods. They observed that phosphorus produced the greatest increase in trunk girth during both the periods and rubber productivity was increased by 97%. Sivanadyan *et al.* (1991) found that application of nitrogenous fertilizers i.e. urea, ammonium sulfate, ammonium chloride and ammonium nitrate increased trunk girth and yield of rubber but the trend was not consistent. The recommended fertilizer dozes are presented in Table 2.1.

2. 8. 1. Time and frequency of fertilizer application

Sivanadyan (1988) emphasized fertilizer application at the proper rate and time and as per requirement of plant, soil and environment. He observed that generally good uptake of nitrogen during the period between defoliation in February/March and refoliation in May and June. The uptake was minimal after hardening of leaves. He further observed that K, P and Mg fertilizer uptake appeared to be continuous during the year. Peng (1988) reported that the effect of fertilizer application could vary from one year to less than three years or even more depending on the nutritional status of tree. He further concluded that in case of gross deficiency, fertilizer application to mature plant can result in yield in one year or less. But in most cases, there was no increase in yield after two years of fertilizer application. Earlier works of Bolton (1968), Soong and Yeoh (1974) and Sivanadyan (1972) showed that leaching losses of nitrogen ranged from 12 to 28% and potassium from 3 to 7% while fertilizers were applied monthly over the year. They suggested to split fertilizer dozes especially on sandy loam to sandy clay loam soils.

2. 8. 2. Zone of application

Fertilizers have to be applied where the active feeder roots are concentrated (Yusoff 1988). The plant roots remain confined to a small circle around the trees during the initial stages after establishment (RRIM 1958). Gradually canopy closes over, the roots extend well into the mid-point of the inter row. It was found that the distribution of active feeder roots of trees older than 5 years increases from about 60 cm from the tree to a peak at about 300 cm away from the tree and thereafter declines. It was suggested that fertilizers should be applied within a strip commencing at about 50 cm to 60 cm and extending up to 300 cm from the tree. Pushparajah *et al.* (1975) applied fertilizers to the tree rows which were in a strip of 3 m wide that covered only one third of the field. In another experiment fertilizer was applied in about one fourth of the area of the rows (Lau 1975).

Likit *et al.* (1996) studied the root distribution of rubber trees by using P^{32}. After soil and leaf analysis they concluded that dense and large amount of active feeder roots remain at a distance 100 cm from the tree in the 0-15 cm soil depth for the immature period. They recommended applying fertilizer for the efficient use approximately at 100 cm and 300 cm from the tree for immature and mature tree respectively.

Table 2. 1. Recommended dozes of fertilizers for mature rubber plantation.

Investigators	Clone/ location	Age	Fertilizer dozes N	P	K	Mg	Remarks
McEwen (1987)	All clones, Bangladesh	Mature rubber	Urea = 100g/ plant/yr	T.S.P.= 200g/ plant/yr	M.P. = 150g/ plant/yr		Author suggested for leaf analysis before fertilizer application
Anam *et al.* (1981)	Ditto	Ditto	5 kg	5 kg	3 kg		Recommended to apply in 20 x 25 m^2 area of Dantmara Rubber Estate
Punnoose *et al*. (1975)	South India	Ditto	34.0 kg/ha/yr	-	100kg/ ha/yr		Results tested insignificant in three expts. but showed increase in yield. P response was nominal as because of high reserve of soil-P
Chan (1971), Guha and Pushparajah (1966), RRIM (1965)	Malaysia						Response is likely where soil and leaf P is low
Guha (1975)	Liberia, W.Africa	Mature rubber	Total combination 150-225 kg/ha/yr.				10-15% increase in yield in application of appropriate combination
Silva (1971)	Sri Lanka	Ditto	680 g/ tree/yr.	-	225 g/ tree/yr.	225 g/ tree/yr.	Where leaf N < 3.20%, K < 1.25%, P-was adequate
BFIDC (1989)	Raojan	Mature and 6 years above	85 g (Urea)	113 g T.S.P.	57 g M.P.		Application of fertilizers per tree, twice in a year, August and April
	Stagaon	Ditto	57 g (Urea)	85 g T.S.P.	57 g M.P.		
	Others Rubber Estates	Ditto	85 g (Urea)	85 g T.S.P.	85 g M.P.		

(contd. table 2.1)

Investigators	Clone/ location	Age	Fertilizer dozes				Remarks
			N	P	K	Mg	
Noor (1988)	TJIR-I PRIM-501	6 yrs. tree/ha 346	728 kg/ha	64 kg/ha	311 kg/ha	119 kg/ha	The doze was applied once in a year
		10 yrs. tree/ha 226	1529 kg/ha	143 kg/ha	501 kg/ha	241 kg/ha	
		33 yrs. tree/ha 267	1779 kg/ha	276 kg/ha	1233 kg/ha	417 kg/ha	
	RRIM-600 Malaysia	6½ yrs. tree/ha 420	635 kg/ha	73 kg/ha	365 kg/ha	103 kg/ha	With increase of tree age, immobilization of nutrients increase.
		15 yrs. tree/ha 335	656 kg/ha	134 kg/ha	874 kg/ha	149 kg/ha	
Angkapradipta *et al.* (1986)	India	Mature	533.34 g urea tree	-	180.36 g / tree	-	Low fertile latosol, P did not show marked yield response. Doze applied once in a year
Yogaratnam and Weerasuriya (1984)	Sri Lanka	Mature	210 g / tree	100 g / tree	190 g / tree	42 g / tree	Rock phosphate did not show always beneficial effect and Mg depressed yield
Reis *et al* (1988),	Brazil	Mature and Immature phase	60 kg/ ha / yr	90 kg/ ha / yr	60 kg/ ha / yr	-	P contributed in trunk girth increment
Onuwaje (1983)	Nigeria	-	500 g/ tree / yr	-	500 g/ tree / yr	250 gm/ tree / yr	P did not show positive result NK Mg increased yield 11%, 3%, 8% respectively
Angkapradipta 1976)	Indonesia	Mature	240 g / tree	162 g / tree	360 g / tree	-	Acid soil, low P, very low NK. Recommended to apply NK and NPK in alternate year.
Adiwiganda (1979)	GT-I	-	126 and 252 gm / tree Urea application				In yellowish brown podzolic soil, reduce the yield by 3% and 6%

2. 9. Cover Crops in Rubber Plantation

The leguminous cover crops; *Pureraria phaseuloides, Desmodium ovalifolium, Mimosa invisa, Calopogonium mucunoides* and *Centrosema pubescens* under rubber plantation of Sri Lanka showed beneficial effect (Jayasinghe 1991). It was found that the decomposition products of cover crop grown with rubber improve the nitrogen economy of soils, especially along with biological, chemical and physical properties of soils. In Malaysia five experiments with the cover crop *Pureria phaseoloides* and with a natural cover crop under rubber plantation showed that the annual yields per hectare with legume cover were higher in the first 3 years of tapping and lower in the next two years than the corresponding yields with natural cover (Mathew *et al.* 1989). It was further observed that cumulative yield with the legume cover over five years amply justified the cost of establishment and maintenance of the cover. Rajasekharan (1990) investigated the establishment cost of rubber plantation with cover crop and found that management costs decreased from second year to the 7th due to decrease in the cost of labour for weeding. In this regard no remarkable work was done in Bangladesh. Khisa (1991) has reported the introduction of *Pureraria javanica, Centrosema* spp. and *Calopogonium* spp. under rubber plantation. He observed that continuation of cover crop management is difficult after completion of canopy closeness.

2. 10. GBH and Latex Yield Data

Girth is a function of tree age, density and site condition (Thomas *et al.* 1993). Grist and Menz (1995) found that tapping at 45 cm girth gave the maximum latex yield over the life cycle of a plantation and that contributed to faster tree growth. They also observed that early tapping at 35 cm girth gave a greater latex yield but short time economic return. But Varnou and Tonnelier (1985) reported overall losses of 10-20% due to early tapping.

Estilai (1991) observed a range of about 1850-6400 kg/ha/yr latex yield. He inferred that optimum age for harvesting depends on the genotypes. Martin and Arruda (1992) concluded that the profitability would be achieved with yield of latex of about 3600 kg/ha/yr. Better profit may be obtained if latex yields remain about 4500 kg/ha/yr. Serier (1989) observed an average latex yield of about 1900 kg/ha/yr in Thailand. Abdulla and Lai (1981) reported the average latex yield of 46 estates, which was about 4500 kg/ha/yr. Ng (1981) studied the affect of tree density (211-1067 tree/ha) for clone RRIM -600 and RRIM-701. He found that average of 8 years of latex yield was about 6960 kg/ha/yr for RRIM-600 at 850 tree /ha but the yield in RRIM-701 was lower due to less tree density (680 tree/ha). But the corresponding yield at the conventional planting density of 400 tree/ha showed 6000-6060 kg/ha/yr. Lee and Tan (1979) studied the variations in daily latex production and dry matter content (DRC) for clones of GT-1, PB5/51, RRIM-6000 and RRIM-701. Those were tapped in two systems for a year and the highest latex yield but the lowest DRC were obtained in RRIM-600. PB5/51 had the lowest yield and the highest DRC under both the systems. On an average, yield in both the systems were more closely associated with daily latex volume than with DRC. It was possible for the Indian Rubber Board to boost up yield within 40 years from about 320 kg/ha/yr to 1422 kg/ha/yr (Patel, 1997) through tree improvement and fertilizer application. Campaignolle and Bouthillon (1955) after 9 years of study concluded that *Hevea* in controlled plots produced about 2.40 kg of rubber per tree per year.

Cardoso and Igue (1990) recorded 92 ml latex/tree/tap in 1983 and 66 ml in 1986, with an average of 83.7 ml in AVROS-1279 clone. In Fx-25 there was 93 ml /tree/tap in 1987 and 60 ml in 1983. Haris and Dereinda (1990) recorded latex production of 1577 kg/ha/yr and which stands as 11.3 kg/tap per day basis. Gowda *et al.* (1990) surveyed the plantations under different companies and private owner in Karnataka. They found that RRII-105, GT-1, RRIM-6000 and TJIR-1 on the average contributed about 2400 kg/ha/yr at the lowest range and 7800 kg/ha/yr in the highest. Olapade (1988) studied 10 *Hevea* clones of RRIN and a control clone of RRIM-600 for 18 months. He found clone C83 having the highest mean latex yield per tapping of 42.15 g/tree and clone C202 the least 22.73 g/tree/tap. Marathukalam and Premakumari (1987) studied the yield and agronomy for 9 rubber clones of Sri Lanka. Among them RRIC-1000 and RRIC-36 showed the highest latex yield of 34.99-37.41 g/tap on yearly average.

In Bangladesh R.S.S and scrap (cup lump and tree lace) ratio for six estates was determined from July to May (Caskie 1983). They found around 9.0% scrap of total R.S.S. but mud lump was found about 50 to 67% of total scrap. In Dantmara Rubber Estate latex and R.S.S., R.S.S. and scrap contents were evaluated for three years based on factory records. It was found that R.S.S. contributed to produce about 8 to 9.20% scrap while latex yielded about 32% of R.S.S.

2. 11. Nutrient returns in *Hevea* litter

Accumulation and releasing of plant nutrients is a continuous process (Yusoff 1988). In the early stage of maturity of rubber, litter of cover crops and to a lesser extent roots of dead trees contribute to their nutrient source. Similarly plants return only a small amount of nutrients to the system (Noor 1988). It was concluded that rubber at the mature stage did not only play the vital role on uptake and utilizing the nutrients available in soil but also serve as the main source of nutrient return. Hassan and Islam (1984) found that leaf litter of rubber contributes organic matter at the rate of 20 kg /t soil/yr (Table 2. 2).

Table 2. 2. Nutrient recycling in *Hevea brasiliensis* (Noor 1988).

Particulars	No. of trees/ha	kg/ha				Clone
		N	P	K	Mg	
Nutrients removed with latex (1400 kg/kg/ha) in normal tapping	297	9.40	2.30	8.30	1.70	PB 86
Nutrients required in growth (kg/ha)	297	39	8	34	11	PB 86
Contribution of litter in mature rubber 3700-7700 kg/ha/yr	297	45-90	3-7	10-20	9-18	PB 86
Seed/ capsules 160 kg/ha/yr	297	2	0.20	0.20	0.20	PB 86
Nutrients immobilized at the age of 33 months	420	140	19	75	9	RRIM 600
Nutrients immobilized at the age 79 months	420	633	73	365	103	RRIM 600
Nutrients immobilized at the age 190 months	335	656	134	874	149	RRIM 600
Nutrients immobilized at the age 6 years	346	728	64	311	119	TJIR 1
Nutrients immobilized at the age 10 years	226	1529	143	510	241	TJIR 1
Nutrients immobilized at the age 33 years	267	1779	276	123?	417	TJIR 1
Nutrient returns by rainwash of leaves at 254 cm rainfall (kg/ha)	-	10	0.5	20	1.5	-
Atmospheric gains of nutrients from dust and rains at 254 cm rainfall (kg/ha)	-	20	0.20	10	3	-
Leaching losses of applied N & K, %*	-	10-30 20-30		10-30	-	-

*10-30% under green house condition and 20-30% in field condition (coarse soil).

2.12. Economic Analysis for Latex Production

Several factors influence the cost of production of latex and rubber. Costs involved in field management, latex collection, processing and others have to be considered to justify profitability of latex production. In a case study in Indonesia during 1984-88, Panjaitan (1990) found that dominant components of cost were tapping and yield collection (29%), whereas general costs (14%) and processing costs (11%) were less. But Sudhardi (1975) assessed the cost involved in tapping and transportation and that was 25% of total expenditure in rubber estates of Indonesia.

In Sao Paulo, Brazil, the costs and returns of established rubber trees and economic viability of investments in new crops were analyzed in 1991 by Martin and Arruda, (1992). They considered different planting and extracting systems, different yield levels and replicating 5 price levels for natural rubber at the producer level. They concluded that only the producers showing yields above 1500 kg/ha could be certain of profitability at present price. Lima *et al.* (1989) found the variable costs accounted for about 55.5% of total costs. Labour payments had a considerable weight in these costs. Brandao *et al.* (1980) found that fixed costs represent over 80% of total costs.

In mature rubber plantation, the cost of manuring (labour and materials) has been evaluated which accounted for 8.5% of the total ex-estate costs (including processing) or about 5% of the total freight on board expenditure. It remains within the range of 4 to 5% while prices of other materials increase with fertilizers cost. (Yew *et al.* 1980; Sivanadyan, 1988). The cost of labour in Ivory Coast was found to be 60% of production costs (Monnier, 1974). Pee *et al.* (1978) analyzed economics of various tapping systems with stimulation on the basis of their net present value with 12% interest. They found that s/2-d/2 (half spiral and alternate day) tapping system is the best one. In calculating the rubber production, 20% scrap of the recorded output of RSS has been estimated (Barlow and Carrad 1975).

2. 1 3. CONCLUSION

Latex, the biological product of rubber trees contributes significantly towards the modern civilization. Realizing the importance of this rubber bearing plants, *Hevea brasiliensis*, its cultivation has been spread from the native Brazil to the Indian subcontinent and many other parts of the world. With trial and errors gradual development in extraction process of latex, genetic improvement of its clone, utilization avenues of latex and rubber products and scientific management of *Hevea* have reached to the present developed phase.

Bangladesh has started rubber cultivation forty years back. But research need has got less priority to enhance latex yield. Experts of home and abroad emphasized research needs in the different fields of rubber production, especially on fertilizer effect on latex production. Scientists have realized that nutrient removal through latex harvest needs to be compensated. For continuous and sufficient production of latex, *Hevea* needs proper management and extra feed. Many countries have achieved improvement in latex yield through fertilizer application, but their recommended doses, time of application and method of application may not be appropriate in Bangladesh due to variation in climatic, edaphic and management factors. Sporadic works were done with growth, soil and leaf nutrients of rubber plantations of some localities but none on fertilizer effect on latex yield. Since rubber cultivation has been given priority both in the government and the private sectors and in rehabilitation of degraded land in hilly and Terrace areas, systematic works are of immense importance. Many different clones have been planted and they grow and produce latex at different rates but the present state of production is unsatisfactory. Since rubber is a long rotation crop, replacement of unproductive or rehabilitation of degraded stands is not easy. The most feasible way of improvement in latex production seems to be better management including judicious fertilizer application.

CHAPTER 3. MATERIALS AND METHODS

MATERIALS AND METHODS

To evaluate the effect of fertilizers on the yield of latex of *Hevea brasiliensis*, a field experiment was conducted with 4 levels of each of N, P and K fertilizers in three sites of Dantmara Rubber Estate, Chittagong. The materials used and the methods employed have been described in the following sections.

3. 1. General Description of the Experimental Sites

3. 1. 1. Location

The experimental sites are situated in the Dantmara Rubber Estate which is under the management of BFIDC. It is the largest rubber estate of the country. The estate is located at Dantmara Union, under Fhatikchhari Thana of Chittagong district. The area, included in this study, lies within latitude 22°54′ North and longitude 91°44′ East. The area is connected by Ramgarh road from Chitagong at a distance of about 90 km. The approximate location of the experimental sites are shown in Fig-3. 1.

3. 1. 2. Site selection

There are about 3000 ha of rubber plantations in the Dantmara Rubber Estate. An extensive exploratory survey of the plantations was done to evaluate status of growth, tree population, distribution of clones and age classes, and variation in condition of land. On the basis of information of this survey, three sites were selected and demarcated. The sites varied in some of their physical environment.

3. 1. 3. Brief description of the experimental sites

The sites of the present study varied in age of trees and clones. The characteristics of the sites are briefly described below:

Site-1 is at Islampur, Dantmara about 2km from the Seed Orchard Centre of BFRI, Hyankhoan and connected by Hyankhoan to Fhatikchhari bound road. At this site, the plantations were raised in 1972 from clonal seedlings of TJIR-1.

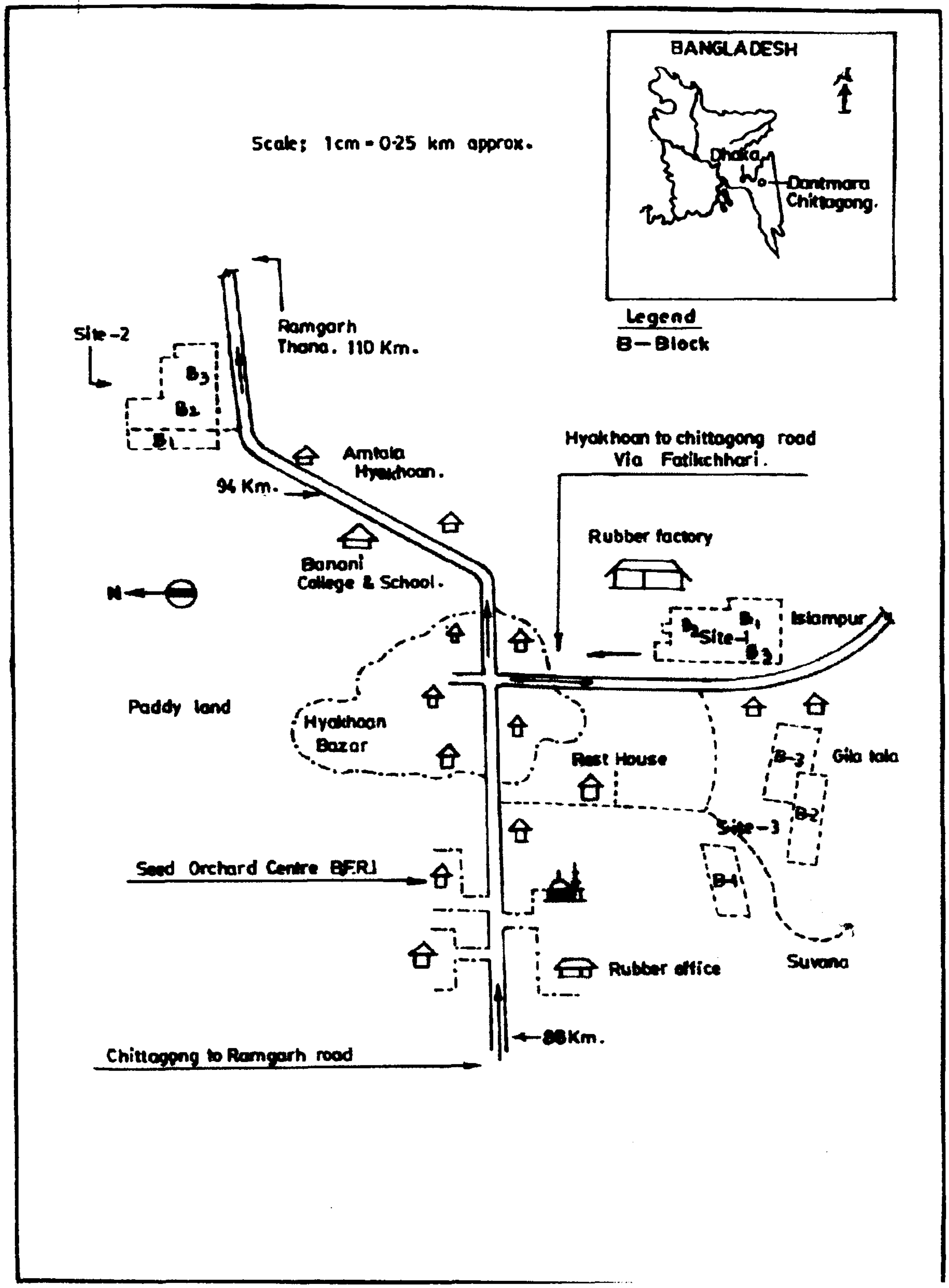

Fig. 3.1 Map of the experimental sites at Dantmara Rubber Estate

The experimental plots were situated on the terrace summit. The elevation is 3 m to 4 m from the adjoining valley. They are generally moderately well drained, gently sloping but terraced, and the slope gradient was eastward. A Chittagong bound road has also passed near by the site.

Site-2 is located at Amtala, attached to the village Hyankhoan, Dantmara, about 4 km away from Hyankhoan Bazar and by the side of Chittagong to Ramgarh road. Here the grafted clones of PBIG (HYV) were planted in 1980.

The experimental blocks are interlaced with each other and occur alomost in the similar terrace. The landform is more elevated (3-5 m) than site-1 and site-3. One of the blocks of this site (block-2) was more elevated than the others. Almost all the boundary of the site is sloping, where nodular concretions are visible by naked eye on the soil surface at a few small patches. Concretions are also found in the substratum at few places of block-1.

Site-3 is at Gilatala, Dantmara, about 2 km from Hyankhoan. The plantation has been raised in 1985 from the grafted clone of RRIM-600. A semi-concrete road which runs to the Suvana Rubber Camp intercepting the Chittagong-Ramgarh road has approached to the site. The experimental plots of the site occur in a terrace land. It is about 2-3 m elevated from the adjoining land, almost flat surfac and moderately well-drained. The block 2 and 3, located in the adjoining hills, are somewhat more elevated and better drained than block-1. The soils are deeply weathered and the blocks are shallowly dissected and interlaced with each other. Fig. 3. 2 shows a view of the experimental sites before and after setting the experimental trial.

3. 1. 4. Status of rubber trees in the experimental sites

The three sites varied considerably in physiognomical features of the trees. The plantations were affected during the devastating cyclone occurred in April 1991. According to Malaysian plantation category, the plantations are of the second to third grade (Wong, 1988). The physiognomical status of all trees in each site were assessed from ocular observation following a particular format (Appendix - VI).

3. 1. 5. Past history of the sites

The land of the area was mainly under natural forests, thickets, weeds, grasses, etc. Due to over exploitation of the forests, a savana type of forests developed there over fifty years ago (Anon 1969). This area of the reserve forest was handed over to the BFIDC at the end of sixties for rubber cultivation. For plantation establishment, field preparation was done by slash and burn of weeds, grasses, etc. In the planting points 30cm x 60cm pits were excavated for planting seedling or clone. The plantation of 1972 (site-1) was raised from seedlings but those of 1980 (site -2) and 1985 (site- 3) by remate. The plantations were fertilized before the cyclone of April 1991. During July to September in the same year, necessary steps were taken to control the weeds and grasses. Later on, neither fertilizer application nor weed control operation was done as informed from Estate records.

3. 1. 6. Infestation of weeds in the sites

The entire areas of the experimental sites were infested with hard and moderately soft stalked shrubs, herbs and creepers. The bushes, weeds, and creepers create problems in tapper's activities and pirate in nutrients of the crops. Some of the creepers were climbing tapping trees. In open canopy, patches of sporadic deep bush were observed in between rows and lines of trees. The average height of weed and wild cover plants ranged from 0.5 to 2 m. The ground coverage was 90-100% in all the blocks. To assess the weed infestation under the different canopy condition and in between the rows of the trees, 5 m × 5 m sampling plots were laid. The weeds/creepers/grasses of the plot were cut at ground level and weighed fresh in the field. A representative sub-sample was carried to the laboratory, dried in an oven at 65°C until constant weight was reached, and dry weight was taken. The type of weeds are given in Appendix VII.

3. 2. Environmental Conditions of the Area Under Study

3. 2. 1. Geomorphology

The low hillocks in the study area are higher in elevation from the south towards the north varying from 18 to 42 m above mean sea level. The land is gently sloping to moderately steep and interlaced by narrow valleys (Hoque *et al.* 1989).

Fig. 3.2 (a) Site view of the experimental site-1

Fig. 3.2 (b) Weed infested plantation before experimentation

The hills of the area are underlain by Tertiary and Quarternary sediments. These were folded, faulted and uplifted and then dissected by rivers and streams (Wadia 1957, Krishnan 1965, Hossain 1985). The low hills of the area occur in the outer flank of the high hill range of Sitakunda-Mirersharai. The parent material has been developed over unconsolidated sandstones and shales. This deeply weathered soil, moderately fined textured with very dark brown well humified top soil belongs to the Ramgarh Series (SRDI 1976). Hassan (1982) stated that sediments of Tertiary hills possess the unconsolidated and semi-consolidated sediments of sandstones, siltstones, shales and conglomerates. The unit includes rocks of the Dupi-Tila series (60-300 m thick) and consists of unconsolidated sediments of late Miocene and Pliocene age (Morgan and McIntire 1959, Krishnan 1965). Coarse "Fossil" mottles and concretionary layers are found at a variable soil depth including localized occurrence of silicified wood. Frequent changes in lithology from sandstone to shale are found and the close dissection of the hill range provides a complex soil pattern in many areas (FAO 1971).

3. 2. 2. Climate

Chittagong enjoys a pronounced tropical monsoon climate. According to Hassan (1982), the climate of Chittagong is fourth humid, megathermal, with little or no season for water deficit. The rainfall of Chittagong (2914 mm) and the experimental sites near at Hyakhoan (2965 mm) is almost similar (Manalo 1975).

Climatic data for the experimental area were recorded from the Dantmara Rubber Estate. The rainfall, temperature and humidity data were collected following standard procedures (Manalo 1975). Data on number of rainy days were also collected from Dantmara Rubber Estate. Recorded data are presented in Appendix VIII. Annual total rainfall was around 2400 mm which is above the average rainfall of the country or below the average of Chittagong. As general trend of rainfall of the country, minimum and maximum amount of precipitation was found within the months of December to February and June to August respectively. Average of maximum (30°C) and minimum temperature (19°C) of the area under experimentation is similar to Chittagong. Leaf fall have been found to occur during December to February. Fluctuation of maximum average temperature within the months of January, the lowest and the highest in May was about 10 °C. Similarly the average of minimum temperature variation was recorded

13 °C within January and October. The maximum and minimum average of annual humidity was recorded 88 % and 67% respectively.

Appendix IX indicates that average number of rainy days was 98 (CV 20%) with a range of 80 to 120 days in the area during 1991 to 1996. The least rainy months were November to February (0-3 days) whereas August showed the highest rainy days (18 days) followed by June (16 days), July (15 days), September (14 days) and October (7 days).

3. 2. 3. Soils

The soils of the area under study are generally deep, moderately well drained, dark yellowish brown to strong brown, strongly to moderately acid, sandy loam to clay loam. Soil properties, specifically color, texture, structure, reaction, and CEC did not show notable difference along horizontal and vertical directions within 0-30 cm soil depth. But there were some variation in these characteristics among horizons of the soil profiles. The overall soil condition of site-2 is better than sites 1 and 3. The sites possess similar land capability class i.e. high (Hassan and Hossain, 1997). According to FAO (1988), the area under study falls in the AEZ –29 (Northern and Eastern Hills).

3. 3. Fertilizer Application and Experimental Design

For the present study fertilizers were applied at a factorial combination of 4 levels of each of urea containing 46%N (N_0=0, N_1= 75g, N_2=150g and N_3=225g/tree), TSP containing 46% P_2O_5 (P_0=0, P_1= 100g, P_2=200g and P_3=300g/tree) and MP containing 60 % K_2O (K_0=0, K_1= 75g, K_2=150g and K_3=225g/tree). In all there were 64 treatment combinations. Each of the three sites was divided into three blocks. Therefore, each block served as one replication for the treatments. Each block was divided into 64 plots. There were four to six trees in each plot. To accommodate the trees, block size varied from 0.98 to 1.37 ha depending on survival and health of trees. Fertilizers were added in a single application in each plot once in a year during September. Fertilizers were applied manually by loosening soil (3-4 cm depth) with a spade within a radius of 1.3 m around each tree base. The arrangement of the treatments in blocks is shown in Table 3. 2. The field layout was, therefore, according to randomized complete block design (Gomez and Gomez 1984).

Table 3. 1. Arrangement of fertilizer treatments in three blocks of each site.

BLOCK-1

$N_2P_0K_3$	$N_0P_0K_0$	$N_3P_0K_1$	$N_2P_3K_1$	$N_2P_3K_3$	$N_0P_1K_1$	$N_1P_1K_2$	$N_1P_0K_1$
$N_3P_2K_2$	$N_0P_3K_0$	$N_2P_0K_2$	$N_3P_3K_3$	$N_0P_0K_3$	$N_1P_3K_2$	$N_0P_3K_3$	$N_1P_0K_3$
$N_1P_2K_3$	$N_2P_2K_0$	$N_0P_0K_1$	$N_3P_1K_0$	$N_2P_2K_2$	$N_0P_3K_2$	$N_1P_3K_1$	$N_0P_3K_1$
$N_3P_2K_1$	$N_3P_3K_1$	$N_1P_1K_0$	$N_3P_1K_2$	$N_1P_2K_2$	$N_1P_2K_0$	$N_2P_1K_1$	$N_0P_2K_0$
$N_0P_2K_2$	$N_0P_1K_2$	$N_2P_1K_3$	$N_1P_0K_2$	$N_3P_0K_2$	$N_1P_1K_3$	$N_2P_1K_0$	$N_0P_0K_2$
$N_3P_2K_0$	$N_2P_1K_2$	$N_1P_1K_1$	$N_0P_2K_3$	$N_2P_3K_0$	$N_1P_3K_0$	$N_0P_2K_1$	$N_0P_1K_3$
$N_3P_0K_0$	$N_2P_2K_1$	$N_3P_3K_2$	$N_3P_0K_3$	$N_3P_1K_1$	$N_1P_2K_1$	$N_3P_2K_2$	$N_2P_3K_2$
$N_3P_2K_3$	$N_1P_0K_0$	$N_3P_1K_3$	$N_2P_0K_0$	$N_2P_2K_3$	$N_2P_0K_1$	$N_3P_3K_0$	$N_1P_3K_3$

BLOCK-2

$N_0P_1K_0$	$N_2P_1K_2$	$N_1P_0K_1$	$N_3P_0K_2$	$N_0P_2K_0$	$N_1P_3K_3$	$N_0P_0K_3$	$N_3P_0K_0$
$N_1P_1K_0$	$N_3P_0K_1$	$N_1P_0K_3$	$N_0P_1K_3$	$N_3P_2K_2$	$N_3P_0K_3$	$N_2P_3K_0$	$N_2P_1K_1$
$N_0P_1K_2$	$N_0P_0K_0$	$N_0P_3K_3$	$N_2P_0K_3$	$N_1P_1K_2$	$N_1P_1K_3$	$N_0P_1K_1$	$N_2P_0K_2$
$N_0P_0K_2$	$N_3P_1K_0$	$N_0P_3K_0$	$N_3P_1K_2$	$N_2P_3K_1$	$N_1P_3K_2$	$N_3P_3K_3$	$N_2P_3K_3$
$N_0P_3K_2$	$N_0P_2K_2$	$N_0P_0K_1$	$N_3P_3K_1$	$N_1P_3K_1$	$N_1P_2K_0$	$N_1P_3K_2$	$N_2P_2K_3$
$N_3P_2K_3$	$N_0P_2K_3$	$N_2P_2K_0$	$N_2P_2K_2$	$N_3P_3K_0$	$N_2P_1K_3$	$N_2P_1K_0$	$N_3P_1K_3$
$N_2P_0K_1$	$N_3P_2K_0$	$N_1P_0K_0$	$N_1P_2K_1$	$N_1P_0K_2$	$N_1P_3K_0$	$N_2P_3K_2$	$N_3P_3K_2$
$N_2P_0K_0$	$N_2P_2K_1$	$N_3P_2K_1$	$N_1P_1K_1$	$N_0P_2K_1$	$N_1P_2K_3$	$N_3P_1K_1$	$N_0P_3K_1$

BLOCK-3

$N_1P_0K_1$	$N_3P_1K_3$	$N_1P_0K_0$	$N_2P_1K_0$	$N_3P_1K_1$	$N_1P_1K_3$	$N_3P_0K_0$	$N_1P_0K_3$
$N_2P_2K_2$	$N_2P_0K_2$	$N_3P_3K_3$	$N_0P_0K_2$	$N_2P_0K_1$	$N_3P_0K_2$	$N_2P_3K_0$	$N_0P_3K_3$
$N_1P_3K_0$	$N_2P_3K_3$	$N_0P_2K_2$	$N_1P_3K_3$	$N_2P_3K_1$	$N_3P_3K_2$	$N_1P_2K_2$	$N_1P_2K_0$
$N_2P_2K_3$	$N_3P_2K_0$	$N_1P_1K_1$	$N_2P_0K_0$	$N_3P_2K_2$	$N_0P_2K_0$	$N_1P_1K_0$	$N_2P_1K_1$
$N_3P_1K_2$	$N_2P_1K_2$	$N_1P_1K_2$	$N_3P_1K_0$	$N_0P_0K_2$	$N_0P_1K_2$	$N_3P_0K_1$	$N_0P_3K_2$
$N_0P_0K_3$	$N_0P_1K_3$	$N_3P_0K_3$	$N_0P_1K_1$	$N_0P_0K_0$	$N_1P_0K_2$	$N_2P_0K_3$	$N_0P_3K_0$
$N_3P_2K_3$	$N_1P_3K_2$	$N_0P_1K_0$	$N_0P_3K_1$	$N_1P_3K_1$	$N_3P_3K_0$	$N_3P_3K_1$	$N_1P_2K_3$
$N_3P_2K_1$	$N_2P_2K_0$	$N_2P_3K_2$	$N_1P_2K_1$	$N_2P_2K_1$	$N_0P_2K_3$	$N_0P_2K_1$	$N_2P_1K_3$

3. 4. Soil Sampling and Analysis

3. 4. 1. Sampling

Similar sampling intensity was followed for each block. Composite soil samples were collected before fertilizer application in September '94. Each composite sample was made by mixing soil of 9-12 soil cores. For each site, nine composite samples (3 at each of 0-15, 15-30 and 30-45 cm depths) were taken. Weeds were removed before taking soil samples. Composite samples were processed for analyses in the laboratory.

Soil samples at depths of 0-15 cm, 15-30 cm and 30-45 cm from each plot were collected after 90 days of fertilizer application (December '94). Next soil sampling was done after one year of fertilizer application (September '95). Similar procedure was followed in the following year for fertilizer application and soil sampling. Three typical soil profiles were excavated at three blocks of each site and studied in the field according to Soil Survey Manual (USDA 1951). Information of the soil profiles and their environmental conditions were recorded in the profile sheets. Soil colour was evaluated in the field following the Munsell Colour Charts (USDA 1973). Three micro-monoliths (Fig. 3. 3) of the profiles and soil samples of their representative horizons were collected, processed and preserved properly for analysis.

3. 4. 2. Analysis

The following physico-chemical analyses were carried out in the Soil Laboratory of BFRI, Chittagong. For determination of particle size distribution and CEC, soil samples collected before fertilizer application were used. Soil pH, organic carbon, total N and available nutrients were determined from soil samples collected before and after fertilizer application.

Particle size distribution

Mechanical composition of soil was determined by hydrometer method according to Day (1965). The textural class was named from the triangular coordinates as devised by Soil Survey Staff (USDA 1951).

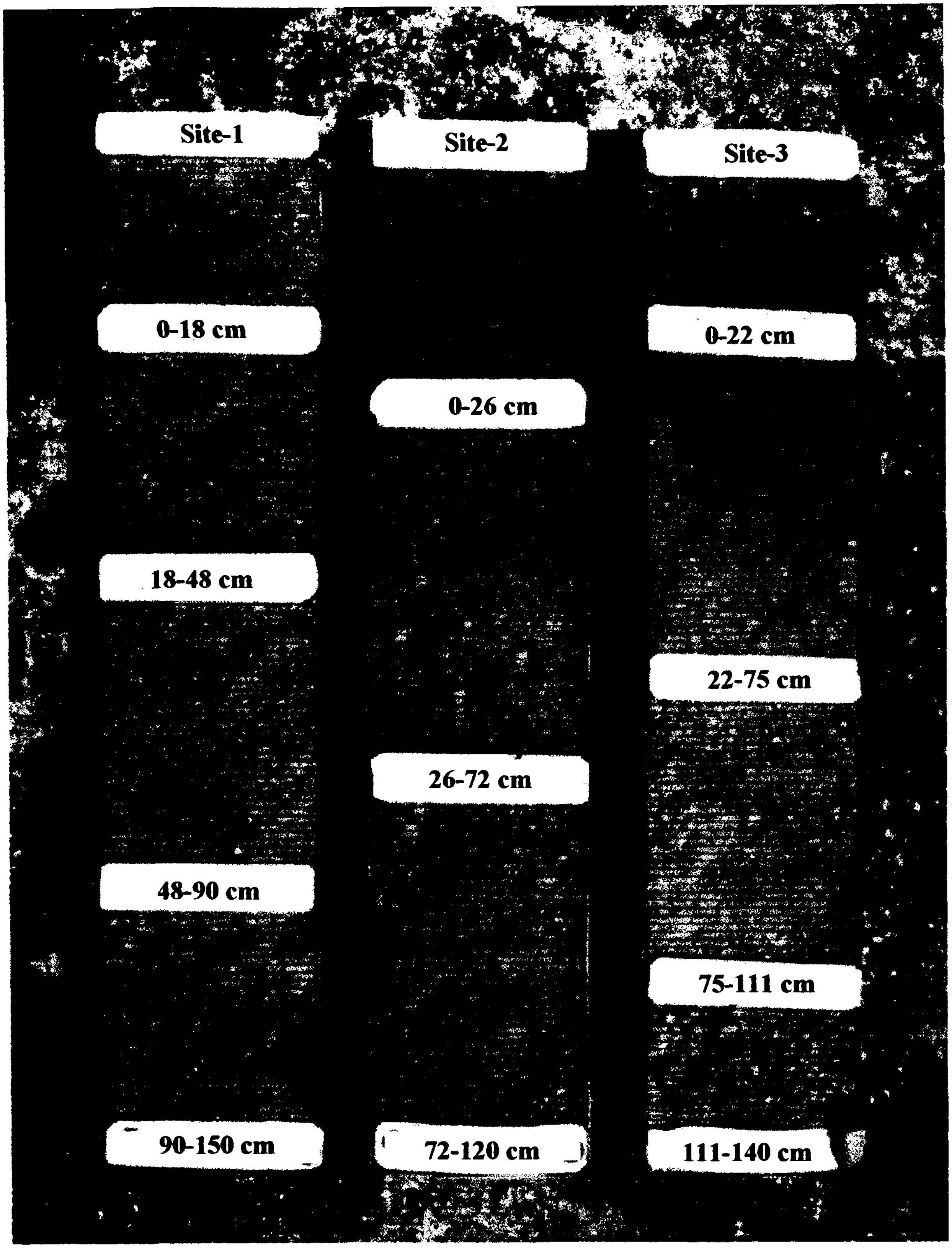

Fig. 3.3 Micromonoliths of the soil profiles for site-1, 2 and 3

Soil pH

Active and potential soil acidity were determined from soil:water (1: 2.5) and soil:1N KCl (1: 2.5) suspensions using digital pH meter.

Organic matter

Organic carbon content of soil was determined following the Wet Oxidation Method as described by Jackson (1973). Soil organic matter was calculated by multiplying organic carbon with 1.72.

Nitrogen

Total nitrogen of the air-dried soil samples was determined by micro-Kjeldahl digestion and distillation method (Jackson 1973).

Phosphorus

Available phosphorus in soil was extracted with Bray and Kurtz No. 1 extractant. Phosphorus content in the extract was determined colorimetrically by developing blue colour according to Page (1982). Total phosphorus was determined by digestion with ternary acid mixture followed by $SnCl_2$ reduced molybdophosphoric blue colour method (Jackson, 1973).

Available nutrients

Available K, Ca, Mg, and Mn were extracted with 1N NH4OAC at pH 7. Concentration of the elements was determined by Double Beam Atomic Absorption Spectrophotometer, Model no GBC-902 (Athanasopoulos and Chapple 1991). Calcium was determined by acetylene -N_2O flame and K, Mg and Mn by air -acetylene flame.

Cation exchange capacity (CEC)

Cation exchange capacity was determined neutral 1N NH4OAc saturation and 10% KCl displacement (Black, 1965). The displaced ammonium was determined by micro-Kjeldahl digestion and distillation followed by titration with standard acid.

3. 5. Leaf Sampling and Analysis

3. 5. 1. Sampling

Before fertilizer application, trees were selected randomly from each block of each site. Leaves of terminal whorl of a spur of branched mature tree were used for sampling as recommended by Lau *et al.* (1990). Three composite samples were prepared from lighted and mostly shaded leaves collected from 15 different trees of each block. In this way total 27 nos. of composite samples were collected for three sites and three blocks. Due care was taken in sample labelling and to avoid dust contamination in the field and laboratory processing. The samples were collected manually before noon.

After 90 days of fertilizer application (December '94) the leaf samples were collected from trees of each plot. Next leaf sampling was done in Septermber '95 i.e. after one year of fertilizer application in the same procedure. Similarly, the sampling was carried out after 90 days, in December'96 and after one year of second fertilizer application i.e. in September'96.

Leaf samples were cleaned by dust free white cloth to remove adhering dust. The leaves were air-dried in room temperature and then oven dried in controlled temperature of 65° C for 24 hours. The dried leaf samples were ground with due care to avoid contamination (Wilde *et al.* 1985). The ground materials were stored in plastic pots with proper labeling.

3. 5. 2. Digestion

Leaf samples were digested with Selenium + Lithium Sulphate + Sulfuric acid + Hydrogen Peroxide digestion mixture for analyses of total N, P, K, Ca, Mg and Mn (Allen *et al.* 1986).

3. 5. 3. Determination of leaf nutrients

Nitrogen was determined by micro-Kjeldahl digestion and distillation. Phosphorus was determined by Vanadomolybdo-phosphoric yellow colour method using

Spectrophotometer (Jackson 1973). The content of elements K, Ca, Mg and Mn in the extract were determined by Double Beam Atomic Absorption Spectrophotometer (Model no GBC-902).

3. 6. Latex Yield

Generally tapped out latex is collected into a cup in the morning. The total latex volume is carried properly to the factory for preparing RSS. The late droppings are collected in the next morning along with the tree lace and cuplump before incision of tapping panel. A sketch of the tapping arrangement is shown in Figure 3.5. The mudlump, the waste coagulated or overflowed latex of the field, is collected at different periods of the year in the area under study. The latex after processing produces the best quality rubber sheet. The scraps (tree lace + cuplump including mudlump) after smoking are sold to the rubber using industries. The latex drying arrangements and bundles of SRS (smoked rubber sheet) are shown in Fig. 3.6. The data of the latex yield was collected in the following procedure and schedule.

3. 6. 1. Latex yield data collecting schedule, procedure and estimation

Following the concept of Pushparajah *et al.* (1975) about latex flowing time and keeping pace with tapping schedule of Dantmara Rubber Estate, the yield data were collected once in a month from October '94 to September '96 i.e. for 24 months. The latex yield data was recorded within 8.45 am to 10.30 am; while there was the least latex flow through the spoutline and almost before condensation in the cup. Latex yield for each treatment was recorded separately with graduated measuring cylinders. The latex yield data of the three replications of a site were recorded in the same day and the other sites on consecutive days. Latex yield data, calculated as cc/plot/tap, were compiled for each month following the format of Appendix X. In each site latex yield data of twelve months were arranged for the period October '94 to September '95 and October '95 to September '96. Following the compiled data, 24 months yield record was arranged replication wise for each treatment. Latex yield per hectare was estimated by multiplying average latex yield/tree/tap with number of trees per hectare and number of tapping days in a year. The average number of tapped trees per hectare was 288 and number of tapping days was 130 per year.

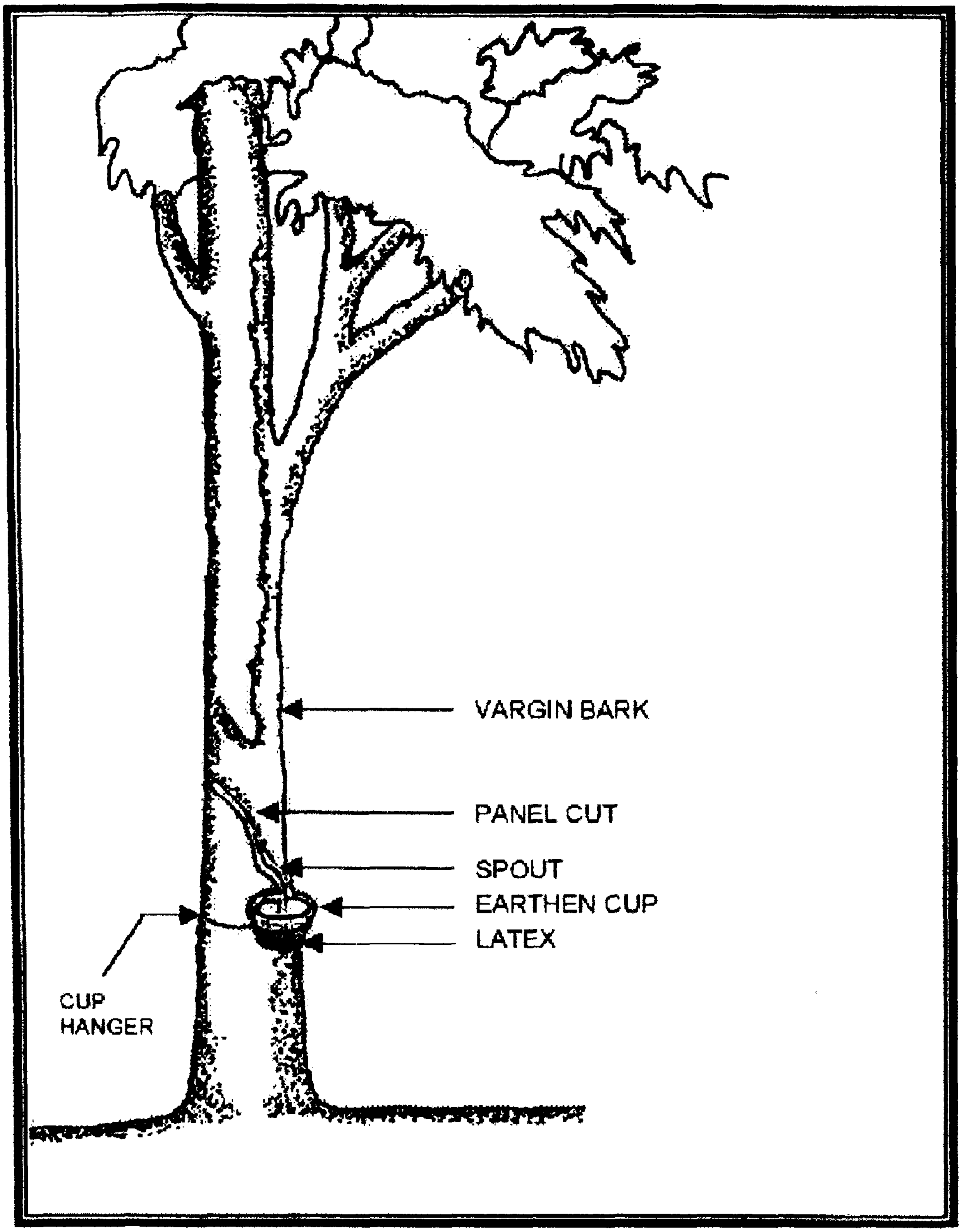

Fig. 3.4 A sketch of the latex collecting arrangement

3. 7. Measurement of girth at breast height (gbh)

The initial gbh (over bark) of 100% trees in each block of the three sites was measured in September '94 following the format shown in Appendix VI. The gbh of trees slightly deformed at 1.3 m were measured immediately below and above the deformation and the average value was recorded.

3. 8. Estimation of Leaf Litter

The deciduation period of *Hevea* species in Bangladesh starts from 15 December to 15 February. The quantity of leaf litter per square meter at 9 different representative spots of each block of site -2 and site -3 was determined in the field at the last week of January. The weighed samples were collected and labeled properly. Representative fractions of the samples were taken to the laboratory, air-dried and then oven-dried at 65 °C for 24 hours. The oven-dried weight of the fractions were used to calculate annual leaf litter yield.

3. 9. Profitability Analysis.

Profitability analysis was done on the basis of costs involved in plot preparation, fertilizers and their application costs and return in the form of latex and its waste products, scrap and mudlump. Variable costs involved in labour for weeding and latex tapping etc. were the same for control and fertilizer treated plots. Therefore, these were excluded from estimation. The average costs of two years for the area under study have been considered for this purpose.

Input cost = Cost of fertilizers
Labour cost = Cost involved in labourer for land preparation, fertilizer application, etc.
Total variable cost = Input cost + labour cost.

Average market prices of fertilizers during the period of investigation were:
Urea = Tk. 4.25/kg,
TSP = Tk. 6.21/kg, and
MP = Tk. 5.39/kg

On an average, labour cost for land preparation was Tk. 288/- and for fertilizer application was Tk. 540.0/ha/yr. In that consideration there was no variable cost in control plots.

Gross Return = Prices of (RSS + Scrap + Mudlump)/ha/yr.

Dry matter content (as ribbed smoked sheet – RSS) in latex was considered to be 28%. RSS contained 12% scrap, 55% of which was mudlump. On these bases, production of RSS, scrap and mudlump per hectare were estimated.

RSS was calculated from latex yield from the following formula:

$$\text{RSS (kg/ha/year)} = \frac{\text{Latex yield /tree (g/day)} \times \text{number of trees per ha} \times 28^{*} \times 130^{**}}{100 \times 1000}$$

*Average percentage dry matter in latex according to factory records.
**Average effective tapping days/year.

From factory records of the Estate, the following prices were taken into estimation:

RSS = Tk 72.94/kg;

Scrap =Tk 39.37 /kg; and

Mudlump = Tk. 7.00/kg

Return above variable cost (RAVC) = Gross return – Total variable cost.

$$\text{Marginal Benefit Cost Ratio (MBCR)} = \frac{\text{Added returns}}{\text{Added costs}}$$

Where,

Added returns = RAVC in treatment – Return in control,

Added costs = Total variable costs

The terms were taken from Theresa (1999) with some modification in derivations to suit present experiments.

3. 10. Statistical Analyses

The field design of the fertilizer trial (factorial combination) was randomized complete block in each of the three sites. Analyses of variance for latex and leaf nutrients were done using SPSS 7.5 and 9.05 taking the effects of single factors and their two and three way interactions into consideration. However, for examining soil properties and gbh, one way analysis was done. The same programme was also used to estimate means, standard error, standard deviation, co-efficient of variations, multiple comparisons, paired tests for partitioning effects of fertilizer levels and periods, t-tests, Duncan's multiple range test (DMRT) etc. Graphs were constructed by MS Excel programme.

CHAPTER 4. RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

In the present investigation fertilizer trials were conducted in three sites of rubber (*Hevea brasiliensis*) plantation at Dantmara Rubber Estate, Chittagong. Tree status, weed biomass, leaf litterfall and soil properties were assessed before fertilizer application. After fertilizer application soil properties were again determined after 90 days in the first year and after two years. Latex production in each fertilizer treatment was estimated per tap basis for consecutive two years. Foliar nutrients were determined block before fertilizer application from each and of some randomly selected treatments after fertilizer application. Results are discussed in detail in the following sections.

4. 1. Physiognomy of Trees

4. 1. 1. Tree status

Description of the sites is given in the chapter on materials and methods. However, the sites were occupied by tree stands of different age groups and there was variation in girth at breast (gbh) and canopy closeness. Physiognomic characteristics also varied. Table 4.1.1 shows the mean values of parameters indicating status of trees in these sites.

Results indicated that in site-1 percentages of affected branch, partly affected crown, partly deformed bark and normal trees were 12, 27, 9 and 52 respectively. In site-2 values for the corresponding parameters were 20, 32, 3 and 45, and in site-3 they were 9, 23, 3 and 65. From ocular observation canopy closeness appeared to be 90% in site-1, 80% in site-2 and 90% in site-3. Therefore, canopy closeness may be considered almost similar in all the sites. Deformation in the bark within the zone of tapping was not considerable in any site.

4. 1. 2. Girth at breast height (gbh)

Values of gbh of different plots of each site have been presented in Table 4. 1. 2. It varied from 74.80 to 93.47 cm with an average of 83.22 cm and co-efficient of variation of 11% in site-1. In site-2, the average gbh was 63.48 cm, range was 55.43 to 70.43 cm and the co-efficient of variation was 9%. In site-3 gbh ranged from 49.60 to 57.47 cm with an average of 53.80 cm and coefficient of variation of 8 %.

Table 4.1.1. Status of trees in the experimental sites of Dantmara Rubber Estate.

Parameters	Site-1	Site-2	Site-3
Age, years	22	14	9
GBH, cm	83.22 ± 8.41	63.48 ± 5.63	53.80 ± 4.32
GBH increment, cm/yr.	3.78 ± 0.11	4.54 ± 0.14	5.97 ± 0.21
Tree form			
Partly affected branch, %	12 ± 2	20 ± 4	9 ± 1
Partly affected crown, %	27 ± 3	32 ± 5	23 ± 3
Partly deformed bark, %	9 ± 1	3 ± 0.2	3 ± 0.1
Normal, %	52 ± 5	45 ± 5	65 ± 6
Canopy closeness, %	90 ± 7	80 ± 9	90 ± 8

Table 4. 1. 2. Mean values of initial gbh (cm) of rubber trees under different treatments.

SL No.	Treatment	Site – 1 (mean ± S.E.)	Site - 2 (mean ± S.E.)	Site - 3 (mean ± S.E.)
1	$N_0P_0K_0$	76.20 ± 2.72	64.30 ± 0.90	54.87 ± 3.44
2	$N_0P_0K_1$	82.80 ± 2.12	64.23 ± 2.05	53.60 ± 5.46
3	$N_0P_0K_2$	76.83 ± 0.86	66.37 ± 2.00	53.57 ± 2.03
4	$N_0P_0K_3$	93.47 ± 2.12	61.13 ± 1.68	51.77 ± 1.52
5	$N_0P_1K_0$	86.67 ± 2.47	66.07 ± 2.87	54.00 ± 1.79
6	$N_0P_1K_1$	84.70 ± 2.21	60.07 ± 1.79	53.13 ± 3.73
7	$N_0P_1K_2$	81.93 ± 3.24	59.87 ± 1.51	50.83 ± 1.53
8	$N_0P_1K_3$	81.17 ± 7.22	58.00 ± 4.54	51.87 ± 3.28
9	$N_0P_2K_0$	76.73 ± 7.62	61.20 ± 1.36	54.00 ± 1.10
10	$N_0P_2K_1$	75.60 ± 5.67	68.60 ± 2.48	50.20 ± 3.18
11	$N_0P_2K_2$	80.87 ± 1.34	64.63 ± 1.49	55.50 ± 6.64
12	$N_0P_2K_3$	84.63 ± 3.23	65.07 ± 2.51	52.93 ± 6.51
13	$N_0P_3K_0$	83.23 ± 5.91	63.87 ± 2.54	56.20 ± 2.86
14	$N_0P_3K_1$	84.90 ± 2.00	62.87 ± 2.73	52.63 ± 1.60
15	$N_0P_3K_2$	80.87 ± 5.17	62.27 ± 1.18	54.83 ± 3.28
16	$N_0P_3K_3$	84.10 ± 4.30	63.07 ± 1.53	51.60 ± 0.91
17	$N_1P_0K_0$	76.80 ± 8.65	58.73 ± 5.55	57.30 ± 1.59
18	$N_1P_0K_1$	85.10 ± 3.72	64.47 ± 1.38	54.87 ± 2.39
19	$N_1P_0K_2$	83.63 ± 3.35	63.97 ± 0.81	58.10 ± 1.90
20	$N_1P_0K_3$	84.43 ± 4.95	58.33 ± 3.13	54.27 ± 0.12
21	$N_1P_1K_0$	74.80 ± 3.33	62.00 ± 4.60	54.67 ± 0.82
22	$N_1P_1K_1$	77.60 ± 3.72	63.20 ± 1.97	54.77 ± 2.25
23	$N_1P_1K_2$	84.47 ± 5.72	64.23 ± 3.0.4	56.73 ± 3.94
24	$N_1P_1K_3$	90.07 ± 3.08	63.10 ± 2.50	52.33 ± 3.23
25	$N_1P_2K_0$	78.80 ± 3.35	64.40 ± 2.71	54.93 ± 1.31
26	$N_1P_2K_1$	84.33 ± 3.77	58.43 ± 3.94	55.57 ± 0.86
27	$N_1P_2K_2$	78.03 ± 3.31	62.57 ± 4.82	54.37 ± 1.73
28	$N_1P_2K_3$	87.57 ± 7.39	66.07 ± 2.03	55.90 ± 2.31
29	$N_1P_3K_0$	83.60 ± 2.09	65.77 ± 1.56	51.17 ± 0.52
30	$N_1P_3K_1$	83.37 ± 7.48	66.30 ± 2.90	54.17 ± 1.48

Contd. Table 4. 1. 2.

SL No	Treatment	Site – 1 (mean ± S.E.)	Site - 2 (mean ± S.E.)	Site - 3 (mean ± S.E.)
31	$N_1P_3K_2$	84.60 ± 2.61	66.93 + 1.32	53.70 + 1.72
32	$N_1P_3K_3$	85.17 ± 1.70	69.47 ± 2.23	52.87 ± 1.35
33	$N_2P_0K_0$	75.83 ± 2.84	63.20 ± 4.81	57.33 ± 0.17
34	$N_2P_0K_1$	78.00 ± 0.92	58.80 ± 0.38	49.87 ± 2.26
35	$N_2P_0K_2$	89.43 ± 8.40	61.87 ± 0.90	56.33 ± 2.40
36	$N_2P_0K_3$	82.10 ± 2.41	66.67 ± 4.32	55.77 ± 2.77
37	$N_2P_1K_0$	84.50 ± 5.34	63.47 ± 3.78	53.37 ± 0.23
38	$N_2P_1K_1$	90.43 ± 4.34	63.17 ± 2.72	51.13 ± 4.40
39	$N_2P_1K_2$	82.37 ± 2.43	69.67 ± 3.53	52.47 ± 2.93
40	$N_2P_1K_3$	78.47 ± 4.33	61.90 ± 3.40	50.40 ± 2.44
41	$N_2P_2K_0$	90.80± 14.3	64.23 ± 3.47	50.37 ± 3.22
42	$N_2P_2K_1$	84.00 ± 2.60	55.93 ± 1.43	54.23 ± 1.14
43	$N_2P_2K_2$	79.70 ± 9.79	64.03 ± 3.06	54.37 + 0.82
44	$N_2P_2K_3$	82.77 ± 1.44	64.03 ±1.01	56.20 ± 1.21
45	$N_2P_3K_0$	88.53 ± 2.05	63.13 ± 5.65	53.70 ± 2.56
46	$N_2P_3K_1$	86.23 ± 10.11	70.43 ± 3.26	53.67 ± 1.93
47	$N_2P_3K_2$	91.53 ± 2.32	63.93 ± 1.15	51.03 ± 0.19
48	$N_2P_3K_3$	89.73 ± 7.07	67.07 ± 2.52	51.30 ± 2.26
49	$N_3P_0K_0$	80.20 ± 1.06	63.80 ± 0.60	55.53 ± 0.73
50	$N_3P_0K_1$	79.17 ± 3.18	66.30 ± 2.80	57.47 ± 0.87
51	$N_3P_0K_2$	78.60 ± 3.45	66.30 ± 2.56	57.00 ± 0.64
52	$N_3P_0K_3$	86.10 ± 0.89	62.97 ± 3.17	54.63 ± 0.12
53	$N_3P_1K_0$	84.20 ± 2.00	63.57 ± 2.26	52.77 ± 2.09
54	$N_3P_1K_1$	82.63 ± 5.97	66.53 ± 4.28	54.13 ± 1.92
55	$N_3P_1K_2$	83.97 ± 9.33	68.57 ± 5.26	53.80 ± 1.72
56	$N_3P_1K_3$	88.10 ± 0.98	64.03 ± 1.56	51.37 ± 2.22
57	$N_3P_2K_0$	75.67 ± 3.08	55.43 ± 4.49	49.60 ± 1.17
58	$N_3P_2K_1$	89.90 ± 4.61	57.83 ± 2.49	53.23 ± 2.24
59	$N_3P_2K_2$	87.23 ± 9.75	62.70 ± 2.90	51.33 ± 1.88
60	$N_3P_2K_3$	80.83 ± 2.71	61.73 ± 4.84	55.67 ± 2.04
61	$N_3P_3K_0$	91.37 ± 6.97	59.07 ± 5.14	54.70 ± 2.31
62	$N_3P_3K_1$	83.17 ± 2.19	63.30 ± 2.03	54.60 ± 1.31
63	$N_3P_3K_2$	86.17 ± 7.68	64.67 ± 3.25	52.63 ± 3.79
64	$N_3P_3K_3$	87.10 ± 6.25	64.93 ± 9.39	53.83 ± 2.64
Mean		83.37 ± 0.64	63.48 ± 0.40	53.80 ± 0.29
CV,%		11	9	8

Variation in gbh was not significant within any of the sites under study (Appendix XI). However, the variation among the sites appears to be considerable. This variation resulted from different ages of the plantations.

The mean annual increment (MAI) in gbh for sites 1, 2 and 3 were determined by dividing the gbh value with respective age of trees. The trend of variation in MAI of gbh among the sites is shown in Fig. 4. 1. 1. It reveals that the MAI in gbh of rubber gradually declined with age of plantation. However, clones were also different in these sites. Different clones might have different rates of growth due to genetic causes. RRII (1995) observed mean annual girth increment of several clones to range from 6.94 to10.02 cm within first three years of plantation. Khisa (1991) reported that increment rate of gbh remained within 5 cm per year in case of grafted or seedling based plantation of rubber after opening taping panel gradual. Punnose *et al.* (1975) did not find significant effect of N, P and K fertilizer treatments on girth increment. Premakumari *et al.* (1991) observed a positive relation between girth and volume of latex.

4. 1. 3. Number of tapped trees

Number of tapped trees in each plot of each bock of the sites has been recorded for 2 years. Table 4. 1. 3 shows month-wise average number of tapped trees for all sites. The average tapped trees for site-1 were 231 in the first year and 193 in the following year. This trend of decreasing average number of tapped trees from first year to second year was also marked in other sites, viz. 244 and 206 in site-2 and 277 and 261 in site-3. In site-1, maximum and minimum number of tapped trees occurred in the months of October and September, respectively. In this site maximum tapped trees in the second year was also observed in October but the minimum was found in July. Maximum values in site-2 were found in October and November respectively in the first and the second year. Minimum values were respectively in August and June. In site-3, maximum number of tapped trees was found in November both in the first and the second year. Minimum number of tapped trees was in February and April, respectively in first and second year in site-3.

Table 4. 1. 3. Average number of tapped trees in the experimental sites for the period October '94 to September '96.

Particulars		Months												
		O*	N	D	J	F	M	A	M	J	JU	A	S	Average
Site-1	1994-95	288.0** ± 5.7	260.0 ± 13.2	267.0 ± 9.3	247.0 ± 18.2	164.0 ± 44.6	247.0 ± 13.1	228.0 ± 18.4	245.0 ± 5.2	231.0 ± 1.7	226.0 ± 11.5	203.0 ± 8.2	169.0 ± 31.0	231.0 ±37.0
	1995-96	267 ± 16.8	244.0 ± 13.9	227.0 ± 9.5	232.0 ± 7.4	177.0 ± 10.6	181.0 ± 8.0	186.0 ± 4.2	175.0 ± 9.1	165.0 ± 13.5	120.0 ± 23.8	166.0 ± 14.3	174.0 14.0	193.0 ±41.0
Site-2	1994-95	285.0 ± 8.5	280.0 ± 11.4	268.0 ± 7.9	275.0 ± 24.6	209.0 ± 67.4	260.0 ± 18.6	210.0 ± 48.0	259.0 ± 24.6	253.0 ± 25.0	246.0 ± 9.5	152.0 ± 15.4	232.0 ± 18.0	244.0 ±38.0
	1995-96	279.0 ± 21.5	286.0 ± 14.8	266.0 ± 1.0	233.0 ± 17.7	181.0 ± 49.6	207.0 ± 17.1	200.0 ± 11.1	188.0 ± 17.2	128.0 ± 6.8	162.0 ± 28.3	174.0 ± 13.9	197.0 ±7.0	208.0 ±49.0
Site-3	1994-95	294.0 ± 2.82	303.0 ± 6.1	301.0 ± 7.6	298.0 ± 13.0	264.0 ± 20.1	288.0 ± 20.8	257.0 ± 42.8	275.0 ± 21.5	285.0 ± 9.7	286.0 ± 22.7	267.0 ± 17.4	275.0 ± 14.0	278.0 ±27.0
	1995-96	282.0 ± 15.4	301.0 ± 4.2	297.0 ± 2.9	293.0 ± 2.5	240.0 ± 62.6	235.0 ± 56.9	176.0 ± 43.7	255.0 ± 29.4	274.0 ± 4.32	251.0 ± 29.8	261.0 ± 36.9	264.0 ± 24.0	261.0 ±34.0

* October, November and December represents the starting of 1994 and 1995, the rest of the months are for the next years.

** Mean of trees with SD± and the fractions of tree number < 0.5 has been ignored and more than that is added with mean.

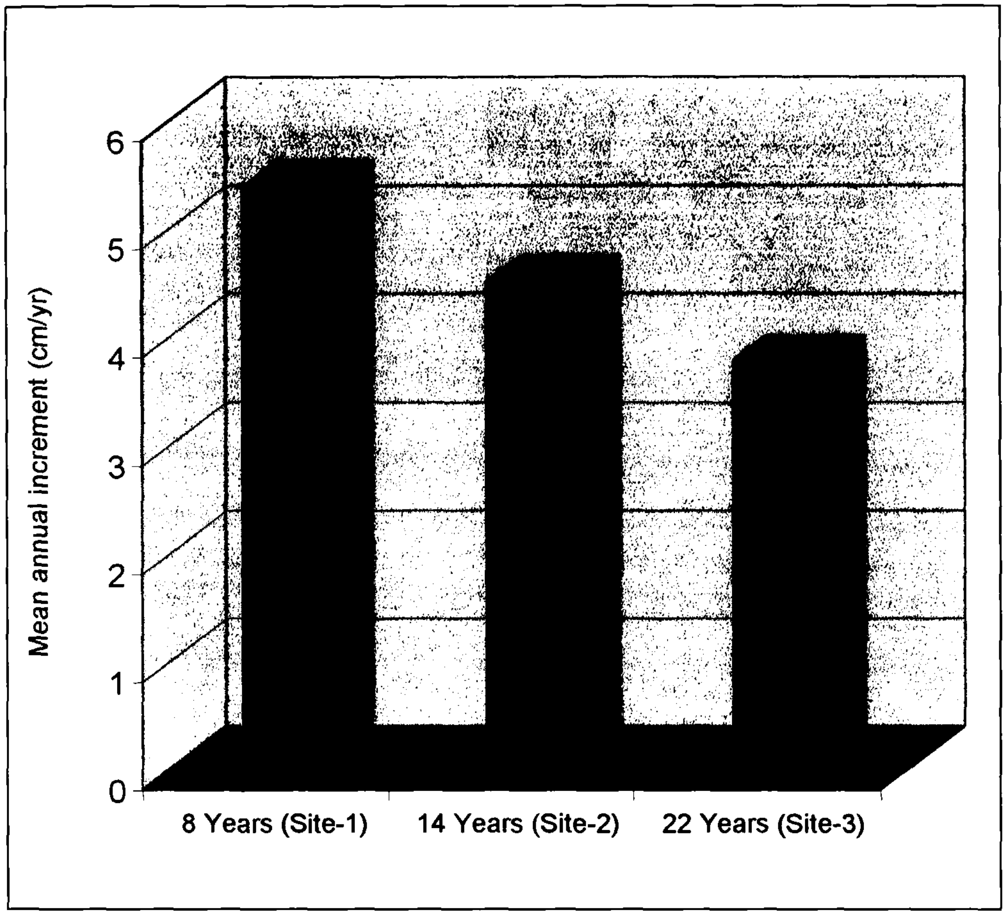

Figure 4.1.1. Mean annual increment of gbh with age of plantation

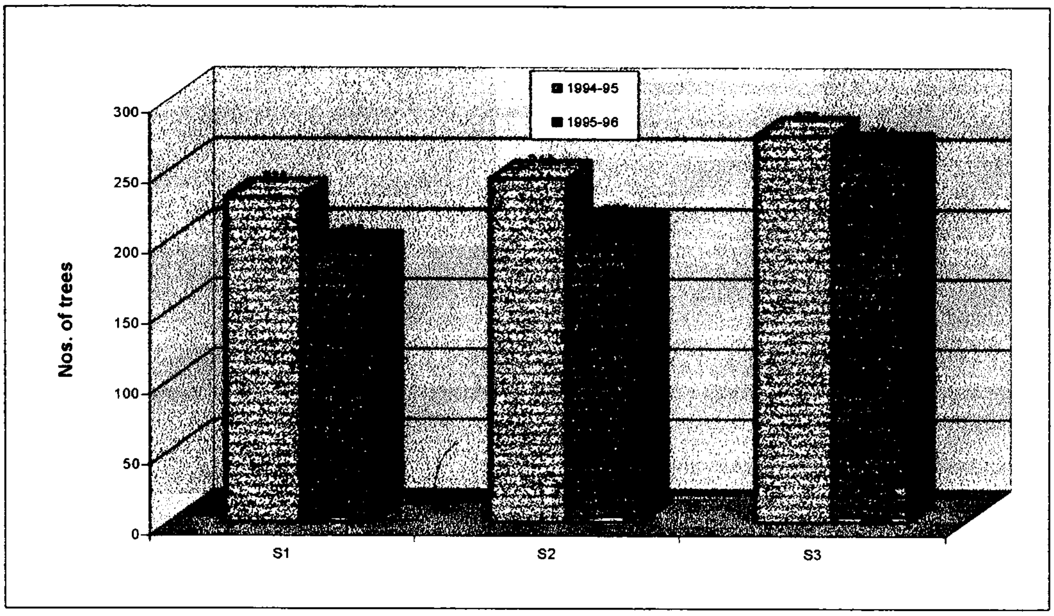

Figure 4.1.2 Numbers of tapped tree in the experimental site during study periods

There was a marked decrease in number of tapped trees during January -April. The reasons of decreasing number of tapped trees may be due to leaf fall and senescence occurring during winter. Some trees exude very little latex during drought period. These trees are excluded from tapping. Number of tapped trees was higher in the post monsoon i.e. September to December. During this time rainfall gradually decreased and environmental conditions for tapping was congenial. At monsoon i.e. May to August, the field remains mostly weed infested, which creates problems in tapping. Sometimes excessive rainfall also interfered in tapping activities and caused late tapping/or no tapping. These may have contributed to reduce the number of tapped trees at that time. The highest number of tapped tress were recorded mostly in October and the least number in July. Fewer numbers of tapped trees in pre -monsoon might be due to moisture stress. It has been found that number of tapped trees generally decreased with age of plantation. Noor (1988) also noted that numbers of tree per hectare starting from age 1-33 years decreased from 445 numbers to 267 numbers where the tree numbers decreased with the increase of age at the rate of 40% of the total and decreasing rate / year was about 3%. Fig. 4. 1. 2 reveals the following sequence on the average number of tap trees: site-3> site-2> site-1. It is pertinent to mention here that site- 1, 2 and 3 had corresponding ages of 22, 14 and 8 years. There was also a clonal variation.

4. 1. 4. Leaf litter

The leaf litter study was not done in site -1 because the site suffered severely from fuel collectors. The amount of leaf litter was estimated in the sites -2 and 3. Data are shown in Table 4. 1. 4 which shows that site -2 produced 1.54-3.40 t /ha/yr leaf litter with an average of 2.25 t/ha/yr. In site -3 there were 1.93 - 3.63 t/ha/yr leaf litter with an average of 2.90 t/ha/ yr. Thus, there was a higher leaf litter production in site-3 than site-2. This higher amount of litter in site -3 may be due to higher canopy coverage. The leaf litter estimates of the present study do not, however, represent total leaf litter production, because some leaf litter fall occurs in other periods not included in the present study. Still these values offer a scope of comparison between the two sites.

Hassan and Islam (1984) reported 6 t/ha/yr leaf litter for Raojan Rubber Estate. About 4.0 t/ha/yr and 3.86 - 7.86 t/ha/yr litter fall were recorded respectively in the Central Experiment Center, Chethackal and Regional Rubber Research Center, Tripura, India. In another site at Mohanpur, Tripura 4.97 t/ha leaf litter was recorded (RRII 1995). Kawahara (1971) reported that in coniferous and deciduous species, the yearly litter fall amounts to 2.5 - 7.76 t/ha/yr. Osman (1996) studied the amount of leaf litter fall of teak in 57 sites in Bangladesh and found the average value of 4.36 t/ha/yr which varied significantly within sites. Noor (1988) reported 3.70 - 7.70 t/ha/yr litterfall in mature *H. brasiliensis*. Amount of leaf litter may vary due to tree density, soil moisture status, landform etc. *Hevea* leaf litter controls evapo-transpiration and conserve soil moisture and ammonical nitrogen (RRII-1994). Ghosh (1978) reported that litter fall forms a mulch to reduce evaporation of water and protects the soil surface against insolation and erosion. In an estimation it was found that for maintaining organic matter in soils of sub -humid and humid regions about 4.0 to 8.0 t/ha/yr litterfall is necessary (Young 1989).

4. 1. 5. Nutrient returns in leaf Litter

Table 4. 1. 5 indicates nutrient content in leaf litter of *H. brasiliensis* in the experimental area. The average nitrogen, phosphorous and potassium concentrations were 1.25, 0.08 and 0.32% respectively in site -2. In site-3 the corresponding concentrations were 1.16, 0.08 and 0.30%. Thus there were higher N and slightly higher K concentrations in site-2. Estimated average N, P and K returns were 28.13. 2.61 and 7.43 kg/ha/yr respectively in site-2 and 33.75, 2.32 and 8.85 kg/ha/yr in site-3.

It appears that N, P, K contents in leaf litter are lower than in green leaf as reported by Noor (1988). RRII (1995) reported N, P, K content of leaf litter for RRII-105 clone that contains 1.66% N, 0.05% P, and 0.54 % K. The higher N and K and lower P than the presented results may be due to clonal variation or other factors. Hassan and Islam (1984) estimated organic matter contribution of 20 kg/t of soil in rubber under controlled condition. They concluded that soil organic matter content reached its climax in October and November and then declined till April, after that it was stabilized. Tan (1975) observed seasonal changes in the nutrient concentration in mature rubber trees. Maximum nutrients were found in green shoot, bark and root tissues at the end of leaf fall. Prior to leaf fall, concentrations of most of the major nutrients except Ca in leaf were the lowest. During the early period of leaf development the nutrients were mobilized from the tissue into the developing leaves. The depletion of nutrients was found maximum after 90-120 days of refoliation. He concluded that as the leaves reached maturity, a very slow build up of excess nutrients occurred in the storage tissues and accelerated at the time of leaf discoloration prior to the next leaf fall.

Table 4. 1. 4. Amount of leaf litter production (t/ha/yr) in the experimental sites.

Leaf litter	Site-1	Site-2	Site- 3
Minimum	ne*	1.62	1.90
Maximum	ne	3.00	3.63
Average	ne	2.25	2.90

*not estimated

Table 4. 1. 5. Nutrient returns in leaf litter.

Sites	N			P			K		
	Max	**Min**	**Av**	**Max**	**Min**	**Av**	**Max**	**Min**	**Av**
Nutrient content, %									
Site-2	1.30	1.20	1.25	0.09	0.08	0.09	0.35	0.31	0.33
Site-3	1. 22	1.10	1.16	0.81	0.08	0.08	0.33	0.28	0.30
Nutrient returns, kg/ha/yr									
Site-2	44.20	18.48	28.13	3.27	1.50	2.61	12.0	4.77	7.43
Site-3	40.80	21.23	33.75	2.90	1.50	2.32	11.98	5.40	8.85

4. 1. 6. Weed biomass in the experimental sites

The entire area under the present investigation was infested with hard, moderately hard and soft stalked weeds annexed by creepers but some part by wild cover plants. A brief list of the known weeds is presented in the Appendix -VIII. The quantities of weed present in the experimental field before fertilizer application are shown in Table 4. 1. 6. In site -1, weed biomass ranged from 0.20 to 0.52 t/ha with the average value of 0.37 t/ha. The highest weed biomass was recorded in site-2, where average weed biomass was 2.59 t/ha and the range was 0.73 to 3.85 t/ha. Site-3 was less infested than site-2 but more than site-1. Minimum and maximum values were 1.73 and 2.17 t/ha respectively and the average was 1.51 t/ha in site-3. In site-1, the management was better than the other sites. Tree density was also higher in site-1. Weed biomass also increased with the openness of the canopy. Weeds density particularly of creepers, grasses etc. create problems in tapers activities. In case of latex collection huge weed infestation is a problem. However, the weed was cleared before the initiation of the fertilizer trial and during the experimental period.

From a similar experiment with teak plantation, Osman (1996) found a range of weed biomass within 1.79 to 7.14 t/ha. Eleven sites had <3.0 t/ha in and six sites >5.0 t/ha. He concluded that low undergrowth is negatively correlated with close canopy and to the method of raising plantation (clear felling followed by slash burning) which destroyed the seeds, seedlings and rhizomes of many species of the past vegetation. Hossain and Chowdhury (1984) studied floristic composition of undergrowth in teak plantation and concluded that biomass and number of undergrowth species were negatively correlated with number of teak trees/ha.

Table 4. 1. 6. Amount of weed biomass (t/ha) in experimental sites.

Weed biomass (oven dry)	Site-1	Site-2	Site-3
Minimum	0.20	0.73	1.73
Maximum	0.52	3.85	2.17
Average	0.37	2.59	1.51
% moisture in fresh weed	90.25	75.50	86.20

4.2. Soil properties

4. 2. 1. Soil profile characteristics

4. 2. 1. 1. Morphological characteristics

Three typical soil profiles were dug out at the representative spots of each site before fertilizer application. General profile characteristics of each site are shown in Table 4. 2.1.

The soils were developed under similar environmental conditions and have properties broadly similar to each other. All the soil forming factors are almost similar except some variation in topography. SRDI (1976) carried out a reconnaissance survey of soil of the area and classified the soils under study as Humic Paleudults. These soils belong to the Ramgarh soil series. Profile characteristics indicated that the soils are well developed and would favour root extension as well as water and nutrient supply. Based on land characteristics including soil properties such as depth, texture, moisture regime, pH and colour etc; land capability class was evaluated as high to very high (Stevens 1987, Hassan and Hossain 1997). According to Richards and Hassan (1989) these soils are highly suitable for rubber cultivation. Typic Paleudlts (TP) and Tropetic Haplorthox (TH) satisfy the soil requirement of rubber while Typic Sulfaquepts (TS) and Typic Tropaquepts (TT) have some limitations. TP and TH soils gave the highest yield where as TT and TS soils showed lowest yield of rubber. Besides, pedological properties of Oxic Dystrochrepts are considered to be intermediate in respect of yield. These groups fall in the Orders Inceptisols, Ultisols and Oxisols (Chan 1975). From extensive studies, some investigators (Noordin *et al.* 1977, Noordin *et al.* 1985) found that rubber could be planted on a wide range of soil types. Rubber was very extensively planted on Ultisols and Oxisols, rather extensively on Inceptisols and less extensively on Entisols and Histosols (Noordin 1988). Chan *et al.* (1974) observed that topsoil with sandy loam and subsoil with sandy clay loam provides less nutrients than clay soil. They further observed that Haplorthox soil has higher productive potential than Sulfic Tropaquepts.

Table 4. 2. 1. Characteristics of the studied soil profiles in experimental sites.

Parameters	Site-1	Site-2	Site-3
Topography	Almost flat	Most flat	Most flat
Drainage	Imperfect to moderate	Imperfect to moderate	Imperfect to moderate
Soil depth	Very deep >1.0 m	Very deep >1.0 m	Very deep >1.0 m
Depth of horizon (cm)	0-18; 18-4 8; 48-90; 90-150.	0-26; 26-72; 72-120.	0- 22; 22 -75; 75 – 111.
Colour (Field condition)	10YR4/4 to 7.5YR 5/8, dark yellowish brown to strong brown	10 YR 3/4 to 7. 5YR 5/8, dark brown to strong brown	10YR 4/4 to 7. 5YR 5/8, dark yellowish brown to strong brown
Texture	Sandy loam to loam	Loam to clay loam	Sandy loam to loam
pH	5.0	5.0	5.1
Structure	Moderate sub- angular blocky	Moderate sub-angular blocky	Moderate sub -angular blocky
Pores	Mostly many, medium tubular	Mostly, many medium, tubular	Mostly many medium tubular
Consistence	Friable moist	Friable moist	Friable moist
Mottling/ concretion	Few fine, faint yellowish brown mottles in 90-150 cm depth	Few fine, faint yellowish, brown mottles in 72-120 cm depth	Few fine faint yellowish brown mottles and few fine Fe / Mn concretion at 111 - 140 cm.
Roots	Fine abundant, medium common and few coarse roots in 0-45 cm but very few fine up to lower limit of the profile	Fine abundant, medium common and few coarse roots in 0-45 cm but very few fine up to lower limit of the profile	Fine abundant, medium common and few coarse roots in 0-45 cm but very few fine up to lower limit of the profile
Boundaries	Mostly smooth but abrupt to clear	Mostly smooth but abrupt to clear	Mostly smooth but abrupt to clear

4. 2. 1. 2. Physico-chemical and nutritional characteristics

The Physico-chemical properties of representative soil profiles in each of the sites are shown in Table 4. 2. 2. Percentage clay distribution within the profiles was almost uniform in all the sites and the values varied within 27 to 34 percent. However, there was considerable variation in silt content with depth of soil. In site-1 percentage silt was higher in the surface soil but in other sites a higher silt content was found in the subsoil. Bulk density was within 1.2 to 1.34 g/cm^3 and showed irregular trend within the profiles. Cation exchange capacity (CEC) ranged from 5 me/100 g to 10.37 me/100 g. CEC was 9.5 me/100 g, the highest in site-2. These values of CEC corroborate with those of Zaman *et al.* (1984). Anam *et al.* (1981) also reported similar results. The soils were uniformly acid throughout the depths and among the sites. When pH of soil in water was considered, the values were within 4.98 to 5.02. But soil pH in 1N KCl (pH 7.0) was found around 3.78. Average organic carbon content in site-1 and 3 was 0.80%, while there was 0.91% in site-2. Thus soils in site-2 was higher in organic matter. As expected, organic carbon content in all the profiles showed a declining trend from topsoil to the depth of more than 120 cm. The total N content followed similar trend of organic carbon. Total N was 0.10% in surface soil of site-2 and 0.09% in site-1 and site-3. In case of total P content, the site-3 showed the highest amount followed by site-2 and site-1. Average total P within profile was 202, 260 and 307 ppm respectively in sites 1, 2 and 3 respectively. In all the profiles total P was higher in the surface soil. The values were 221, 408, 412 ppm in the above corresponding sites. The available P content showed a similar sequence (Table 4. 2. 2). Available P contents of the surface horizon were 23, 28 and 38 ppm respectively in sites 1, 2 and 3. Total and available P values of the present study are higher than those reported by Anam *et al.* (1981). Available K content in soils of the sites was almost similar, the average value being around 13.5 me/100g. It showed irregular distribution pattern in the profile. Available K values in the present study were comparatively less than those reported by Miah *et al.* (1991). An irregular trend of variation was found in the distribution of available Ca content with depth of soil, but in most cases the amount was higher in the lower horizons. Average available Ca contents were 3.38 me/100g in site-1; 2.71 me/100g in site-2 and 2.16 me/100 g in site-3. Available Mg content in each site was around 0.29 me/100g which showed slight variations within the horizons (Table 4. 2. 2).

Table 4. 2. 2. Physico-chemical properties of soil profiles at the experimental sites.

Site No.	Depth cm	Granulometric analysis		Texture	Bulk density g/cc	Soil pH		O.C. %	Total N (%)	Phosphorus (ppm)		Available (me%)				C.EC (me/100g soil)	Available (ppm)	
		Clay %	Silt %			H_2O	KCl			T*	A**	K	Ca	Mg	Na		Fe	Mn
1	0-18	30	26	SCL	1.16	5.01	3.80	1.28	0.09	221	23	0.14	2.26	0.24	0.26	5.80	3.17	12.82
	18-48	29	17	L	1.28	4.89	3.76	0.90	0.07	201	18	0.13	2.08	0.32	0.26	5.40	2.84	4.66
	48-90	30	18	L	1.22	5.02	3.78	0.60	0.05	197	20	0.13	1.72	0.32	0.21	5.31	0.67	4.93
	90-150	27	15	L	1.31	4.98	3.71	0.40	0.05	188	13	0.13	2.15	0.24	0.28	4.12	2.61	5.39
2	0-26	29	16	L	1.28	4.97	3.75	1.32	0.08	408	28	0.13	2.28	0.28	0.21	10.37	1.83	20.35
	26-72	30	27	CL	1.18	5.00	3.78	1.01	0.08	297	23	0.15	2.81	0.33	0.20	9.94	10.88	10.73
	72-120	29	26	CL	1.18	4.98	3.81	0.41	0.09	310	12	0.14	3.05	0.30	0.14	8.16	3.20	7.52
3	0-21	34	7	SCL	1.44	5.00	3.80	1.31	0.06	412	38	0.14	2.25	0.29	0.12	6.18	1.63	5.08
	21-67	29	14	L	1.31	5.08	3.76	0.80	0.05	312	30	0.13	2.05	0.28	0.18	5.11	3.35	8.98
	67-120	34	13	L	1.28	4.99	3.82	0.30	0.07	198	10	0.13	2.85	0.30	0.20	5.80	1.62	9.87

* Total, ** Available

On an average, there was about 0.18 me/100 g soluble Na. However, a slightly higher Na content was found in site-1. Available Fe content was almost similar in each profile, above 2.2 ppm. It showed irregular distribution pattern with depth. Available Mn ranged from 4.66 to 20.35 ppm and was higher in soils of site-2.

4. 2. 2. Soil properties before fertilizer application

Before fertilizer application composite soil samples were collected from 0-15, 15-30 and 30-45 cm depths for each site separately. Samples were analyzed and the data are presented in Table 4. 2. 3. The soils contained predominantly sand with more clay than silt resulting in sandy loam to clay loam texture. In some cases a uniform texture was obtained throughout the depths studied but in many other instances soil texture differed with depth. Somewhere it was finer at a lower depth. Among the sites soil texture was comparatively finer in site -2 than site-1 and site-3 in the subsoil and substratum. This variation could have developed from slight differences in landform, which may have contributed to eluviation of finer clay particles. The higher percentage of sand in site-1 and 3 might also be due to colluvial deposition of sand particles.

The pH values in water varied within a very narrow range from 4.7 to 5.0. The soils were, thus, very strongly acidic in reaction with average pH of 4.8 (0-45 cm depth). However, pH values in 1N KCl solution (pH 7.0) were considerably lower, average value being around 3.7. The K^+ ions released some of the H^+ ions adsorbed on colloidal surfaces and depressed the pH values.

Organic carbon contents of soil of all the sites showed a similar trend of variation within the depths. The highest amount of organic carbon was found in the topsoil followed by subsoil and substratum. The average organic carbon contents in site-1, site-2 and site-3 were 0.98, 1.27 and 1.07 percent respectively. Variations in organic carbon content might be due to differences in the amount of litter fall and human interference. C/N ratio showed a descending tendency from the topsoil to the substratum. In the topsoil C/N ratio varied from 12 to 15. Average values of C/N ratio in sites 1, 2 and 3 were 12, 14 and 15 respectively (Table 4. 2. 3).

Table 4. 2. 3. Physicochemical properties of studied soils before fertilizer application (eomposite samples).

Site No.	Block No.	Soil depth (cm)	Mechanical composition (%)			Texture	pH		O.C. (%)	C/N	Exchangeable bases (me/100g)				TEB (me/100 g)	BSP (%)	CEC (me/100 g)
			Sand	Silt	Clay		H_2O	KCl			Na	K	Ca	Mg			
1	1	0-15	64	9	27	SL	4.91	3.73	1.37	14	0.12	0.07	1.88	0.20	2.29	42	5.50
		15-30	64	11	25	SL	4.98	3.76	1.18	15	0.10	0.09	1.42	0.21	1.83	47	3.90
		30-45	64	11	25	SL	4.98	3.70	0.85	14	0.18	0.07	1.92	0.21	2.38	40	5.90
	2	0-15	48	21	31	L	4.73	3.74	0.85	9	0.16	0.08	1.59	0.18	2.01	47	4.26
		15-30	64	14	22	SL	5.04	3.86	0.62	9	0.14	0.07	1.62	0.27	2.10	50	4.21
		30-45	54	17	29	L	4.88	3.75	0.32	11	0.17	0.09	1.86	0.11	2.23	48	4.61
	3	0-15	52	17	31	L	5.11	3.78	1.36	12	0.11	0.10	1.22	0.18	1.69	51	3.15
		15-30	46	18	36	L	5.05	3.84	1.16	13	0.22	0.12	1.97	0.15	2.46	45	5.49
		30-45	50	15	35	L	5.04	3.71	1.14	14	0.18	0.11	1.63	0.21	2.13	43	4.95
2	1	0-15	47	21	32	L	4.90	3.73	1.36	10	0.24	0.11	2.72	0.37	3.44	41	8.42
		15-30	48	23	29	L	4.71	3.66	1.16	12	0.27	0.15	3.32	0.34	4.08	40	10.18
		30-45	48	18	34	L	4.65	3.71	1.14	13	0.17	0.08	1.53	0.22	2.00	49	4.05
	2	0-15	46	19	35	L	4.96	3.83	1.86	17	0.14	0.09	1.94	0.30	2.47	40	6.25
		15-30	47	22	31	L	4.79	3.76	1.47	15	0.28	0.17	2.96	0.24	3.65	39	9.47
		30-45	47	27	26	CL	4.78	3.79	0.76	10	0.25	0.14	3.24	0.26	3.89	43	9.04
	3	0-15	44	27	29	CL	4.90	3.67	1.52	17	0.13	0.09	2.69	0.25	3.16	35	8.92
		15-30	42	17	41	L	5.29	3.74	1.11	16	0.12	0.08	2.42	0.28	2.90	31	9.27
		30-45	46	19	35	L	4.88	3.79	1.10	18	0.11	0.10	2.10	0.32	2.63	46	5.69
3	1	0-15	51	18	31	L	4.73	3.62	1.53	17	0.15	0.09	2.82	0.27	3.33	40	8.33
		15-30	51	21	28	L	4.66	3.68	1.08	15	0.18	0.09	1.68	0.34	2.29	45	5.04
		30-45	48	10	42	L	4.67	3.68	0.53	13	0.16	0.08	2.14	0.32	2.70	44	6.19
	2	0-15	62	8	30	SL	5.10	3.73	1.51	14	0.19	0.09	1.51	0.30	2.09	39	5.40
		15-30	52	14	34	L	5.03	3.67	1.24	16	0.21	0.10	1.71	0.28	2.30	43	5.29
		30-45	62	6	32	SCL	4.71	3.58	0.65	13	0.31	0.21	3.09	0.34	3.95	46	8.50
	3	0-15	62	9	29	SL	4.90	3.84	1.48	19	0.20	0.09	2.73	0.28	3.30	45	7.31
		15-30	50	15	35	L	4.73	3.90	1.03	15	0.22	0.14	2.05	0.26	2.67	39	6.84
		30-45	59	7	34	SCL	4.80	3.81	0.54	9	0.19	0.10	1.96	0.28	2.53	43	5.88

Calcium was the most dominant cation among the exchangeable bases determined from soils of the sites. Exchangeable Ca was the highest in site- 2. In 0-15 cm soil of this site, exchangeable Ca varied between 1.94 and 2.72 me/100g. It was the lowest in site-1. In this site surface soil contained 1.22 to 1.88 me/100g exchangeable Ca. Soils of site-1 were also poorer in exchangeable Mg, Na and K. Exchangeable Mg generally remained below 0.20 me/100g in site-1. In other sites it was above this level (Table 4. 2. 3).

Average cation exchange capacity (CEC) values of soils (0-45 cm depth) were 4.66, 7.92 and 6.53 me/100g in sites 1, 2 and 3 respectively. CEC is the function of the amount and types of colloids in the soil as well as organic matter. Generally, soils of finer texture and of higher humus contents have greater CEC. In soils of similar ranges of clay, CEC should depend on the organic matter content (Brady 1995). Base saturation percentage (BSP) was generally higher in soils of greater pH values. Like CEC, total exchangeable bases (TEB) were the highest in site-2 and the lowest in site-1. The average values of TEB in these corresponding sites were 2.12 to 3.47 me/100g. The total average TEB values in 0-45 cm were within 2.69 me/100g in all the sites. Results of most of the physico-chemical characteristics discussed above are in accordance with the findings of Anam *et al.* (1982). Zaman *et al.* (1984) earlier reported an average of 13.9 me/100g CEC, 2.1 me exchangeable Ca^{++}, 1.0 me Mg^{++}, 0.20 me K^{+} and 0.30 me exchangeable Na^{+}/100g soil of Dantmara Rubber Estate. He also determined these parameters from soils of Raojan, Dabua and Ramu Rubber Estates. In these soils, CEC ranged from 6.5 to 19.1 me/100g soil. Exchangeable Ca and Mg varied within 1.0 to 1.3 and 0.4 to 0.9 me/100g soil respectively. Most values of exchangeable and available Ca^{++}, Mg^{++}, K^{+} and Na^{+}/100g in soil of the present investigation were similar to their results from soils of Dantmara Rubber Estate. However, TEB and BSP were higher in the present study (Table 4. 2. 3).

According to Yew (1988) the desirable criteria for rubber cultivation were as follows: Soil depth should be up to 100 cm and must be free of iron pan/rock out crop. Well drained soil, good aeration, good soil water holding capacity, no peat or acid peat deeper than 20 cm, soil texture preferably 35% clay to retain sufficient moisture and nutrients and 30% sand to allow good aeration and drainage are suitable. Desirable physiographic features are gentle slope or rolling terrain between 2 and 9^{0} (4-20%) with minimal soil erosion and surface run-off. Water table should be deeper than one meter without saline or acid sulfate conditions. In the light of the above characteristics the soils under present investigation appear to be suitable for rubber cultivation.

4. 2. 3. Nutritional properties of soil before fertilizer application

Table 4. 2. 4 shows the nutritional properties of composite soil samples of the experimental sites collected before fertilizer application.

Total N content of soil was about 0.10 percent in 0-15 cm soil depth in all the three sites. The amount of N showed a decreasing trend downward. The highest amount (0.14%) was found in the 0-15 cm depth of site -2. Other workers (Anam *et al.* 1981, Zaman *et al.* 1984) reported almost similar total N contents. Teak soils in the same Ramgarh series were found to contain about 0.05 % total N (Osman 1996). Total P content was the highest (468 ppm) in site-2 within 0-45 cm depth, while both sites 2 and 3 showed around 315 ppm on an average. Likewise available P content was higher in site-2 than the other sites. Available P ranged from 13 to 33 ppm in 0 to 45 cm depths in all the sites. Available K concentration of soil was similar in site-1 and site-2, where the ranges were 0.14 to 0.22 me /100g and 0.14 to 0.24 me/100g respectively. In site-3 it remained more or less constant (0.13 to 0.14 me/100g). These values are similar to those observed by Osman (1996). Available Ca showed irregular variation with depth of soil. The average values were 2.53, 2.18 and 2.14 me /100g respectively in sites 1, 2 and 3. Available Mg in soil showed an approximate homogeneity in distribution at different depths. The average Mg concentration within 0-45 cm depth was 26, 42 and 36 me/100g respectively in the sites 1, 2 and 3. Anam *et al.* (1982) assessed the quantity of available Mg in Dantmara soils under immature rubber plantation and obtained a slightly less amount than the present results. Available Fe showed irregular variation with depth of soil. The average values of available Fe were 2.37, 2.40 and 2.57 ppm in sites 1, 2 and 3 respectively within 0-45 cm soil depth. Irregular distribution was also found in case of available Mn. The average contents were 7.9, 15.0 and 8.38 ppm respectively in sites 1, 2 and 3.

Yew (1988) suggested that at least medium levels of N, P, K, Mg and sufficient amounts of trace elements are required for optimum growth of rubber. Punnoose *et al.* (1975) rated soil fertility as low, medium and high based on N, P and K values. According to them 1.0 to 2.5 me/100g available P and 5.0 to 12.5 me/100g available K were considered to be indicative of a medium fertile soil. Taking these values as standard, the present soils may be considered poorly to moderately fertile as far as cultivation of rubber is concerned.

Table: 4. 2. 4. Nutritional properties of soils before fertilizer application (composite samples).

Site No.	Block No.	Soil depth (cm)	Total N (%)	Total P (ppm)	Available (ppm)			Available (me/100g)		
					P	Fe	Mn	K	Ca	Mg
1	1	0-15	0.10	229	25	1.3	9.82	0.18	2.32	0.25
		15-30	0.08	235	22	2.28	8.41	0.22	2.03	0.24
		30-45	0.06	315	18	1.32	13.48	0.19	3.03	0.23
	2	0-15	0.10	184	13	2.43	10.91	0.19	1.97	0.23
		15-30	0.07	217	15	3.22	8.77	0.17	2.57	0.41
		30-45	0.03	225	17	0.14	4.16	0.17	3.60	0.24
	3	0-15	0.11	524	20	4.65	7.37	0.17	3.11	0.19
		15-30	0.09	472	24	3.47	4.51	0.14	2.28	0.28
		30-45	0.08	426	26	2.50	4.24	0.17	1.82	0.26
2	1	0-15	0.14	449	27	3.65	17.54	0.21	3.22	0.47
		15-30	0.10	431	28	1.23	9.39	0.18	2.07	0.40
		30-45	0.09	408	32	2.51	6.71	0.17	1.62	0.38
	2	0-15	0.11	539	33	4.52	33.0	0.24	2.07	0.45
		15-30	0.10	489	28	4.27	23.63	0.21	2.54	0.39
		30-45	0.08	436	20	1.98	9.96	0.19	1.97	0.42
	3	0-15	0.09	508	22	1.02	6.96	0.15	1.60	0.39
		15-30	0.07	472	20	1.34	6.36	0.14	1.94	0.40
		30-45	0.06	483	18	1.12	22.69	0.17	2.60	0.50
3	1	0-15	0.09	465	26	0.91	6.59	0.17	2.59	0.34
		15-30	0.07	503	18	1.29	4.81	0.15	1.77	0.37
		30-45	0.04	461	22	1.49	4.42	0.15	1.74	0.37
	2	0-15	0.11	257	25	3.06	7.24	0.15	3.06	0.36
		15-30	0.08	307	27	3.48	4.65	0.13	1.88	0.36
		30-45	0.05	248	31	3.63	17.07	0.15	1.55	0.38
	3	0-15	0.08	209	20	3.00	8.60	0.16	3.00	0.35
		15-30	0.07	189	18	3.47	12.33	0.13	2.10	0.40
		30-45	0.05	243	23	3.00	9.33	0.14	1.60	0.33

4. 2. 4. Nutrient status of soil after 90 days of fertilizer application

Soil core samples from the depths of 0-15 and 15-30 cm for the treatments of each block of all sites were collected after 90 days of fertilizer application. Total N and available P, K, Ca and Mg contents were determined and the values are presented in Appendices XII- XVI.

Total N

As shown in Appendix XII mean total nitrogen content of soil in 0-15 cm (0.10%) and 15-30 cm depths (around 0.07 %) did not differ within the sites. The coefficients of variation of mean total N were 20% for 0-15 cm and 14% for 15-30 cm depths. The ranges of total N for 0-15 cm depth were 0.07 to 0.15, 0.08 to 0.14 and 0.07 to 0.13 % respectively in sites 1, 2 and 3 respectively. In the 15-30 cm, total N content showed the following ranges: 0.06 to 0.11% in site-1, 0.04 to 0.13% in site-2 and 0.06 to 0.10 % in site-3.

Available P

Available P values are given in Appendix XIII. The mean values were 22 - 23 ppm in 0-15 cm soil. Mean values of available P in 15-30 cm depth were slightly less than above and varied around 19 ppm in all the sites. The coefficients of variation of mean available P were 13 to 21% among depths and sites. The ranges of available P were 19 to 38, 14 to 33 and 14 to 30 ppm in 0-15 cm soil respectively of the sites 1, 2 and 3. In 15-30 cm available P content showed the following ranges 13 to 28, 11 to 26 and 10 to 25 ppm in the corresponding sites. Available P of soil at this period was comparatively lower than those obtained before fertilizer application from composite soil samples.

Available K

The results showed that the mean available K contents in 0-15 cm depth of soil in sites 1, 2 and 3 were 0.24, 0.28 and 0.29 me /100g with coefficients of variation of 38, 29 and 24% in the sites 1, 2 and 3 respectively (Appendix XIV). In 15-30 cm depth average available K values were around 0.18, 0.22 and 0.22 me/100 g in site-1, 2 and 3 respectively with 33, 27 and 32% coefficient of variation. In sites 1, 2 and 3 the contents of available K were 0.10 to 0.41, 0.15 to 40 and 17 to 39 me/100g respectively in 0-15 cm, while there were 0.11 to 0.31, 0.12 to 0.35 and 0.12 to 0.38 me/100g in 15-30 cm of those corresponding sites. Available K contents after one year of fertilizer application were comparatively higher than the composite samples collected before fertilizer application. The variation in available K contents of soil between the depths was irregular.

Available Ca

Mean available Ca contents in 0-15 cm depth were 2.25, 2.16 and 3.10 me /100g having 34, 29 and 21% coefficients of variation in sites 1, 2 and 3 respectively (Appendix XV). In 15-30 cm depth the corresponding sites showed 3.21, 2.17 and 2.94 me/100g mean available Ca with 49, 31 and 35 % coefficients of variation.

The ranges of available Ca in 0-15 cm soil in sites 1, 2 and 3 were 1.16 to 3.64, 1.19 to 3.58 and 1.83 to 4.41 me/100g respectively. In 15-30 cm, the ranges were 1.64 to 7.75, 1.14 to 3.91 and 1.40 to 5.50 me/100g in the above corresponding sites. Available Ca content after one year of fertilizer application was slightly higher compared to those determined before application of fertilizers. The variation in Ca content between soil depths showed an irregular trend. The Ca content in the 15-30 cm depth of site-1 and site-2 was higher than site-3.

Available Mg

The results presented in Appendix XVI showed that the mean available Mg contents in 0-15 cm were 0.18, 0.31 and 0.36 me/100g and the coefficients of variation were 28, 39 and 31 % in sites 1, 2 and 3 respectively. In 15-30 cm, the available Mg values were around 0.26, 0.24 and 0.17 me/100g in those sites respectively with coefficients of variation of 38, 42 and 41 percent. Ranges of available Mg in 0-15 cm soil of site-1, site-2 and site-3 were 0.16 to 0.33, 0.16 to 0.68 and 0.21 to 0.61 me/100g, respectively while in 15-30 cm it showed ranges of 0.13 to 0.63, 0.13 to 0.58 and 0.08 to 0.38 me/100g. Content of available Mg in 0-15 cm at this period in site-1 was generally lower than the composite and profile samples collected before fertilizer application. The plants might have absorbed some Mg during period. The variation of Mg between 0-15 and 15-30 cm depths were irregular. Fertilizer application did not show any sign of increase of available Mg.

4. 2. 5. Nutrient status of soil after two years of fertilizer application

Site-1

Soil samples of the control and some other randomly selected treatments were analyzed for nutrients after 2 years of fertilizer application to observe any change in soil nutrient reserves.

Table 4. 2. 5 shows the contents of total N and available P, K, Ca and Mg of site-1. In this site, total N of 0-15 cm depth was the minimum (0.06%) in the treatment $N_0P_3K_0$. The highest concentration (0.10%) was found in treatments $N_1P_0K_2$ and $N_3P_2K_2$. Most of the values were around 0.08%. In 15-30 cm depth there was almost no variation among the treatments. The values lay within 0.07 to 0.08%. Available P ranged from 15 ($N_0P_0K_0$ and $N_2P_0K_1$) to 28 ppm ($N_3P_2K_2$) in 0-15 cm and from 11 ($N_1P_2K_2$) to 20 ppm ($N_3P_2K_1$) in 15-30 cm. Minimum available K (0.08 me/100g) in 0-15 cm depth was found in the treatment $N_0P_0K_0$ while in 15-30 cm it was same in $N_0P_1K_2$. In 0-15 maximum available K (0.24 me/100g) occurred in treatment $N_3P_2K_2$. Maximum available K (0.23 me/100g) was found in ($N_2P_0K_1$) 15-30 cm. The lowest and the highest concentrations of available Ca in 0-15 cm depth were observed respectively in $N_0P_0K_0$ (1.63 me/100g) and $N_2P_0K_2$ (2.30 me/100g). In 15-30 cm depth, it varied between 1.63 ($N_0P_3K_2$) and 2.45 me/100g ($N_2P_0K_2$). In both the depths of soil available Mg was minimum in the control plots. Maximum available Mg in 0-15 cm was found in $N_3P_1K_3$ (0.37 me/100g). In 15-30 cm, it was the highest in $N_1 P_2 K_2$ (0.28 me /100g).

F-values for total N and available P, K, Ca and Mg due to applied fertilizers as well as due to depth of soil have been presented in Table 4. 2. 6. Detail analyses of variance are shown in Appendices XVII - XXI. Total N and available P as well as Mg of soil did not vary due to any of the added nutrients. Applied K fertilizer produced significant variation (5% level) in available K of soil. Available Ca of soil varied significantly due to applied nitrogen.

Table 4. 2. 5. Total N and available P, K, Ca and Mg contents in soils of site- 1 after 2 years of fertilizer application (i.e. September, 1996).

NPK level	Total N (%)		Av. P (ppm)		Av. K (me/100g)		Av. Ca (me/100g)		Av. Mg (me/100g)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
000	0.08	0.08	15	14	0.08	0.12	1.63	2.13	0.21	0.18
012	0.08	0.07	20	18	0.13	0.08	1.55	1.68	0.24	0.21
030	0.06	0.08	25	17	0.12	0.09	1.78	1.95	0.28	0.26
032	0.09	0.07	21	19	0.20	0.15	1.59	1.63	0.27	0.27
102	0.10	0.08	18	14	0.18	0.20	1.78	1.93	0.26	0.21
120	0.09	0.08	19	17	0.13	0.12	1.98	2.09	0.24	0.18
121	0.09	0.07	23	16	0.20	0.17	2.01	2.32	0.28	0.24
122	0.07	0.08	17	11	0.17	0.21	1.73	1.92	0.31	0.28
201	0.08	0.08	15	14	0.21	0.23	1.88	2.03	0.29	0.27
202	0.08	0.08	19	16	0.19	0.16	2.30	2.45	0.30	0.24
313	0.08	0.08	18	14	0.13	0.17	1.59	1.78	0.37	0.22
321	0.08	0.08	23	20	0.11	0.14	1.65	1.98	0.30	0.27
322	0.10	0.08	28	19	0.24	0.16	1.78	1.83	0.28	0.25

Table 4. 2. 6. F-values for variation in nutrients of soil with added fertilizers in site-1.

Sources of variation	F-values				
	Total N	Available nutrients			
		P	K	Ca	Mg
N	1.41 ns	2.94 ns	1.13 ns	5.75*	0.57 ns
P	1.32 ns	1.39 ns	2.06 ns	0.02 ns	2.49 ns
K	0.19 ns	0.14 ns	6.41*	0.89 ns	1.20 ns

ns= not significant and * = significant at 5% level

Site -2

Soils of the control and some other randomly selected treatments were analyzed for nutrients after 2 years of fertilizer application to observe any change in soil nutrient reserves.

Table 4. 2. 7 shows the contents of total N and available P, K, Ca and Mg of site- 2. In this site, total N of 0-15 cm depth was the minimum (0.09%) in the treatments $N_0 P_0 K_0$ and $N_0 P_0 K_3$. The highest concentration (0.16%) was found in treatment $N_2P_3K_3$. Most of the values were around 0.13%. In 15-30 cm depth total N was the lowest (0.07%) in treatment $N_0P_2K_2$ and the highest (0.13%) in treatments $N_2P_1K_2$ and $N_2P_3K_3$.

Available P ranged from 17 ($N_0P_0K_3$) to 28 ppm ($N_2P_3K_1$) in 0-15 cm. Here most of the values of available P were within 22-25 ppm. In 15-30 cm, minimum and maximum concentrations were found respectively in treatments $N_0P_0K_3$ (11 ppm) and $N_1P_3K_1$ (23 ppm). Most of the values of available P were within 17-20 ppm. The lowest and the highest concentrations of available K in 0-15 cm were 0.13 and 0.26 me/100g respectively in treatments $N_0P_0K_0$ and $N_2P_3K_3$. Treatment $N_1P_3K_1$ (0.09 me/100g) showed the lowest available K in 15-30 cm depth while treatment $N_0P_2K_2$ had the highest (0.20 me/100g).

The minimum and maximum available Ca in 0-15 cm depth have been found in treatments $N_0P_0K_3$ (1.32 me/100g) and $N_2P_3K_3$ (2.63 me/100g) respectively. In 15-30 cm, the treatments $N_0P_0K_3$ and $N_2P_3K_3$ showed minimum (1.47 me/100g) and maximum (3.68 me/100g) available Ca respectively. Available Mg in 0-15 cm was the highest (0.40 me/100g) in treatment $N_2P_1K_2$ while the lowest (0.22 me/100g) in treatment $N_2P_3K_3$. In case of 15-30 cm, the lowest available Mg was 0.18 me/100g in $N_1P_3K_1$ and the highest 0.31 me/100g was in treatments $N_2P_0K_2$ and $N_2P_1K_2$.

F-values for total N and available P, K, Ca and Mg due to applied fertilizers and their interactions as well as due to depth of soil have been presented in Table 4. 2. 8 and detail analyses of variance are given in Appendices XXII - XXVI. Total N, available P, K and Mg of soil did not vary due to any of the added nutrients. Applied P fertilizer carried out significant variation (5% level) in available Ca of soil. It might be due to the presence of Ca in TSP which was used as source of P.

Table 4. 2. 7. Total N and available P, K, Ca and Mg contents in soils of site- 2 after 2 years of fertilizer application (i.e. September, 1996).

NPK level	Total N(%)		Av. P (ppm)		Av. K (me/100g)		Av. Ca (me/100g)		Av. Mg (me/100g)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
000	0.09	0.10	20	18	0.13	0.16	1.45	1.48	0.28	0.21
003	0.09	0.08	17	11	0.23	0.19	1.32	1.47	0.23	0.27
020	0.11	0.09	19	17	0.17	0.13	1.43	1.58	0.30	0.24
022	0.10	0.07	20	13	0.23	0.20	1.42	1.56	0.22	0.21
032	0.12	0.08	25	21	0.22	0.14	1.40	1.53	0.27	0.23
131	0.15	0.09	27	23	0.14	0.09	2.27	3.35	0.27	0.18
202	0.12	0.12	21	18	0.23	0.18	1.86	2.10	0.28	0.31
211	0.14	0.12	21	20	0.21	0.17	1.34	1.49	0.29	0.22
212	0.14	0.13	21	17	0.24	0.15	1.60	1.78	0.40	0.31
231	0.14	0.11	28	19	0.23	0.13	2.24	3.33	0.28	0.24
233	0.16	0.13	26	17	0.26	0.16	2.63	3.68	0.22	0.29
312	0.12	0.12	22	19	0.20	0.12	1.60	1.81	0.49	0.30
332	0.11	0.12	24	14	0.25	0.18	2.50	2.63	0.33	0.28

Table 4. 2. 8. F-values for variation in nutrients of soil with added fertilizers in site-2.

Sources of variation	F-values				
	Total N	Available nutrients			
		P	K	Ca	Mg
N	1.59 ns	0.42 ns	1.01 ns	2.83 ns	0.64 ns
P	0.05 ns	0.83 ns	0.36 ns	5.92**	1.03 ns
K	2.57 ns	0.64 ns	1.39 ns	0.50 ns	0.69 ns

ns= not significant and ** = significant at 1% level.

Site –3

Soils of the control and some other randomly selected treatments were analyzed for nutrients after 2 years of fertilizer application to observe any change in soil nutrient reserves in this site too. Table 4. 2. 9 shows the contents of total N and available P, K, Ca and Mg. Total N of 0-15 cm depth was the minimum (0.07%) in the treatment $N_3P_1K_1$ and $N_1P_0K_3$. The highest concentration (0.10%) was found in treatment $N_1P_2K_1$. Most of the values were around 0.08%. In 15-30 cm depth there was almost no variation among the treatments except a few. The values lay within 0.07 to 0.08%. The highest N concentration was found in treatment $N_1P_2K_1$ (0.13%). Available P ranged from 16 ($N_0P_0K_0$) to 28 ppm ($N_1P_3K_2$) in 0-15 cm and from 11 ppm ($N_3P_1K_1$) to 21 ppm ($N_1P_3K_2$) in 15-30 cm.

Minimum available K (0.09 me/100g) in 0-15 cm depth was found in the treatment $N_0P_2K_1$ while in 15-30 cm it was 15 me/100g in $N_3P_0K_2$. In 0-15 cm, maximum available K (0.21 me/100g) occurred in treatment $N_3P_0K_2$ and $N_1P_0K_3$. In 15-30 cm maximum available K (0.23 me/100g) was found in $N_0P_2K_1$. The lowest and the highest concentrations of available Ca in 0-15 cm depth were observed respectively in $N_1P_2K_1$ (1.32 me/100g) and $N_1P_3K_2$ (2.50 me/100g). In 15 - 30 cm depth, it varied between 1.47 ($N_1P_2K_1$) and 2.67 me/100g ($N_1P_3K_2$). Minimum available Mg in 0-15 cm was found in $N_0P_2K_1$ (0.24 me/100g) and maximum (0.38 me/100g) in treatment $N_2P_1K_1$. In 15-30 cm it was the highest (0.28 me/100g) in $N_2P_1K_1$ and the lowest (0.21 me/100g) in $N_1P_0K_3$ and $N_1P_0K_0$.

F-values for total N and available P, K, Ca and Mg due to applied fertilizers and their interactions have been presented in Table 4. 2.10. Analyses of variance are shown in Appendices XXVII – XXXI. Total N, available P, K, Ca and Mg of soil did not vary due to any of the added nutrients.

However, there were significant differences in available P, Ca and Mg in site-1, in available P and K in site-2 and in available P, K and Mg in site-3 within soil depths (Table 4. 2. 11). Total N of site-1 and –3, available K of site-1, available Ca of site-2 and 3, and available Mg in site-2 did not show any effect of soil depth (Appendices XXXII – XXXIV).

Table 4. 2. 9. Total N and available P, K, Ca and Mg contents in soils of site-3 after 2 years of fertilizer application (i.e. September, 1996).

NPK level	Total N(%)		Av. P (ppm)		Av. K (me/100g)		Av. Ca (me/100g)		Av. Mg (me/100g)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
000	0.08	0.07	16	17	0.12	0.17	1.71	2.00	0.31	0.23
010	0.08	0.07	20	13	0.13	0.21	1.42	1.68	0.28	0.25
021	0.09	0.08	21	16	0.09	0.23	1.39	1.49	0.24	0.24
100	0.09	0.07	20	14	0.10	0.18	1.59	1.80	0.30	0.21
103	0.07	0.07	19	12	0.21	0.19	1.48	1.57	0.34	0.28
121	0.10	0.13	23	18	0.17	0.19	1.32	1.47	0.38	0.25
132	0.09	0.08	28	21	0.19	0.21	2.50	2.67	0.29	0.23
211	0.09	0.08	18	12	0.14	0.17	1.43	1.61	0.38	0.28
222	0.09	0.07	21	17	0.14	0.18	1.38	1.60	0.27	0.26
223	0.08	0.08	22	20	0.16	0.20	2.39	1.53	0.33	0.24
230	0.08	0.07	24	18	0.19	0.18	2.00	2.38	0.26	0.23
302	0.09	0.07	22	16	0.21	0.15	1.76	1.68	0.31	0.27
311	0.07	0.08	19	11	0.20	0.17	1.51	1.68	0.30	0.24

Table 4. 2. 10. F-values for variation in nutrients of soil with added fertilizers in site-3.

Sources of variation	F-values				
	Total N	Available nutrients			
		P	K	Ca	Mg
N	3.31 ns	0.10 ns	0.29 ns	0.27 ns	1.10 ns
P	0.00 ns	0.00 ns	0.36 ns	1.91 ns	0.01 ns
K	0.46 ns	0.19 ns	1.16 ns	2.57 ns	0.70 ns

ns= not significant.

Table 4. 2. 11. F-values for variation in nutrients with depth of soil.

Site	F-values				
	Total N	Available nutrients			
		P	K	Ca	Mg
1	2.65 ns	9.68**	0.15 ns	4.71*	8.57**
2	4.38*	14.41***	16.10***	1.92 ns	3.34 ns
3	1.44 ns	18.70***	5.16*	0.45 ns	20.99***

ns= not significant, * = significant at 5%, ** = significant at 1% and ***= significant at 0.1% level.

In connection of the effects of fertilizers on soil nutrient availability, results of some other workers may be cited. Gopalasundarm and Yusuf (1989) inferred that fertilizer application generally enhanced available soil P and K contents, whereas available N was seldom affected. Pushpadas *et al.* (1974), from a 14 years study on the effect of ammonium sulfate/nitrate (68 kg/ha/yr), rock phosphate and muriate of potash (90 kg/ha/yr) showed that N fertilizers lowered soil pH and available K, Ca and Mg. The effect was more pronounced in surface soils down to a depth of 7.5 cm.

4. 3. Leaf nutrients

To assess effects of fertilizers on latex yield, concentration of leaf nutrients at different periods were determined. The results are presented in the Tables 4. 3. 1 to 4. 3. 16 for discussion.

4. 3. 1. Leaf nutrient contents before fertilizer application.

Table 4. 3. 1 presents concentrations of N, P, K, Ca, Mg and Mn in leaves of *H. brasiliensis* in the experimental sites before fertilizer application. Leaf N ranged from 2.91 to 3.45 % with an average of 3.04%. Mean N concentrations were 3.12, 3.02 and 2.98% in sites 1, 2 and 3 respectively. Concentration of P was almost similar in three sites, the average of which was 0.24%. Mean concentrations of K were 0.73, 0.94 and 1.04 % in sites 1, 2 and 3 respectively. Foliar K ranged from 0.69 to 1.06 %, the average value of which was 0.90 %. Calcium concentration in leaf ranged from 0.88 to 1.21% with an average value of 1.02%. Mean concentration was the highest in site-1 (1.18%). The range of foliar Mg was within 0.42 to 0.67% and the average value was 0.53 %. The highest concentration was found in site-3 followed by site-1 and site-2. Mean Mn concentrations were 502, 347 and 338 ppm in sites 1, 2 and 3 respectively. In 110 rubber plantations of China, Wang (1987) found that Mn contents in leaf ranged from 31-2167 ppm. He remarked that rubber leaf normally contained 150-330 ppm of Mn but the quantity varied remarkably with soil type. He also noted the symptom of leaf yellowing due to Mn deficiency in rubber trees. The present plantations appear to have adequate Mn.

McEwen (1987) reported the leaf nutrient values of some of the rubber Estates of Bangladesh. He suggested leaf N values of 3.50%, 3.20-3.50%, 2.90-3.20% and 2.60-

2.90% as high, medium, low and very low respectively for shaded leaf samples. Leaf P values of 0.22%, 0.20-0.22%, 0.18-0.20 % and 0.15-0.18% were of the above corresponding levels. In case of K, the values were 1.40%, 1.20-1.40%, 1.00-1.20% and 0.80-1.00% respectively as high, medium, low range and very low. On the other hand, 0.24%, 0.21-0.24%, 0.18-0.21% and 0.15-0.18% leaf Mg were considered high, medium and low and very low respectively. All these contents were slightly higher than the expected values in exposed leaves. In Malaysia, Indonesia, and Africa, the Ca values were 0.60-0.80%, 0.90-1.20%, 0.40% respectively and in Bangladesh it may apparently be about 1.10%. The present foliar nutrient values before fertilizer application corroborate well with those of McEwen (1987). RRIM (1963) standardized N, P, K and Mg levels, below or above which response of fertilizer was likely or no response under exposed and shaded leaves. It was mentioned that leaf N concentration varied between 3.20% and 3.30% under exposed sunlight and 3.60-3.70 % under shaded canopy condition. In the first case response of N is likely but no response in the second condition. Similarly, K response is likely when its range is 1.0-1.30% in leaves of sunlight and there would be no response while concentration remains 1.40-1.50% in shaded conditions. In case of P, response is likely at 0.19-0.21% in exposed leaf, while there might be no response at 0.25-0.27% under shaded condition.

Table 4. 3. 1. Leaf nutrients of *H. brasiliensis* (mean ±S.E) before fertilizer application (ie. September, 1994).

Site	Block	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Mn (ppm)
1	1	3.45±0.21	0.26±0.03	0.81±0.08	1.15±0.18	0.51±0.06	570±28
	2	2.92±0.34	0.21±0.04	0.69±0.06	1.18±0.27	0.52±0.03	464±23
	3	3.00±0.28	0.22±0.02	0.69±0.07	1.21±0.34	0.58±0.04	471±33
	Mean	**3.12±0.27**	**0.23± 0.03**	**0.73± 0.05**	**1.18±0.13**	**0.54±0.04**	**502±21**
2	1	2.58±0.12	0.18±0.01	1.00±0.09	0.88±0.15	0.43±0.02	330±14
	2	3.39±0.27	0.25±0.02	0.88±0.05	1.08±0.12	0.42±0.03	327±19
	3	3.09±0.21	0.22±0.03	0.94±0.07	0.96±0.11	0.46±0.02	383±27
	Mean	**3.02±0.29**	**0.22±0.02**	**0.94±0.06**	**0.97±0.10**	**0.44±0.01**	**347±17**
3	1	3.02±0.33	0.24±0.04	1.06±0.10	0.88±0.13	0.66±0.05	344±21
	2	3.00±0.18	0.23±0.03	1.06±0.09	0.91±0.09	0.54±0.04	372±24
	3	2.91±0.31	0.24±0.04	1.00±0.11	0.90±0.06	0.67±0.07	298±26
	Mean	**2.98±0.02**	**0.24±0.02**	**1.04± 0.03**	**0.90±0.09**	**0.62±0.07**	**338±21**

4. 3. 2. Leaf nutrients after fertilizer application

4. 3. 2. 1. Concentrations and variations

Fertilizers were applied in the month of September '94 in the experimental sites. Leaf samples were collected in December '94, after 90 days of fertilizer application and in September '95 after one year of fertilizer application. From the total 64 leaf samples of each treatment at all sites, control and 12 other samples were selected randomly at each term. Concentration of N, P, K, Ca, Mg of these samples were determined and tested statistically.

Nitrogen

Table 4. 3. 2, 4. 3. 3 and 4. 3. 4 contain data of leaf N of four different periods: December '94, September '95, December '95 and September '96 in sites 1, 2 and 3 respectively. In site-1 leaf N ranged from 2.32 (control) to 3.20% ($N_3P_2K_1$) in the 13 treatments included during December '94 with a mean value of 2.80%. The mean values varied at 11%. In September '95 the mean value was 3.37% and the control had 3.21%. The maximum content was 3.71% in treatment $N_1P_2K_1$. The ranges of leaf N in December '95 and September '96 were 2.77 to 3.78% and 2.94 to 3.40% respectively with corresponding mean values of 3.17% and 3.22%. Thus, leaf N was higher in December '95 than December '94, but the trend was reverse in September. The coefficient of variation was low in September (7% only) of both the years. In site-2, however, mean leaf N values were 2.98%, 3.15%, 2.97% and 3.16% respectively in December '94, September '95, December '95 and September '96. The coefficients of variation were between 5 and 9 percent. So, the mean values did not differ much from the individual values. In site-3 mean leaf N contents were 2.97% and 3.21% in December '94 and September '95 respectively with coefficients of variation between 8 and 9 percent. In the second year i.e. in December '95 and September '96 the corresponding mean values were 2.92 and 3.12 with 6% coefficient of variation.

Table 4. 3. 2. Leaf N (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site 1.

NPK Level	Dec. '94 after 90 days	Sep. '95 after 1 year	NPK Level	Dec. '95 after 90 days	Sep. '96 after 1 year
000	2.32 ± 0.14	3.21 ± 0.13	**000**	3.14 ± 0.11	3.21 ± 0.10
012	3.0 8± 0.09	3.59 ± 0.21	**012**	2.77 ± 0.24	3.03 ± 0.20
021	2.76 ± 0.15	3.45 ± 0.15	**030**	3.30 ± 0.15	3.40 ± 0.12
030	2.72 ± 0.06	3.35 ± 0.06	**032**	3.18 ± 0.05	3.27 ± 0.05
100	2.73 ± 0.21	3.34 ± 0.08	**102**	3.26 ± 0.14	3.33 ± 0.12
121	2.69 ± 0.09	3.71 ± 0.08	**120**	3.25 ± 0.25	3.38 ± 0.15
123	2.75 ± 0.07	3.55 ± 0.12	**121**	3.78 ± 0.27	2.94 ± 0.24
211	2.88 ± 0.15	3.36 ± 0.09	**122**	2.96 ± 0.07	3.15 ± 0.04
231	3.03 ± 0.10	3.14 ± 0.09	**201**	3.17 ± 0.20	3.26 ± 0.19
312	2.52 ± 0.00	3.22 ± 0.25	**202**	2.81 ± 0.16	3.00 ± 0.10
313	2.66 ± 0.11	3.43 ± 0.16	**313**	3.18 ± 0.10	3.29 ± 0.11
321	3.20 ± 0.21	3.09 ± 0.17	**321**	3.23 ± 0.07	3.29 ± 0.07
322	3.06 ± 0.06	3.36 ± 0.17	**322**	3.11 ± 0.11	3.27 ± 0.12
Mean	2.80 ± 0.05	3.37 ± 0.04	**Mean**	3.17 ± 0.08	3.22 ± 0.04
%CV	11.00	8.00	**%CV**	16.00	7.00
LSD 5 %	0.18	0.20	**LSD 5%**	0.31	0.19
1%	0.25	0.28	**1%**	0.42	0.25

Table 4. 3. 3. Leaf N (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site-2.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	2.88 ± 0.02	3.02 ± 0.02	000	2.95 ± 0.02	3.07 ±0.03
031	2.93 ± 0.02	2.99 ± 0.06	003	2.91 ± 0.01	3.00 ± 0.01
113	3.00 ± 0.08	3.02 ± 0.02	020	2.91 ± 0.02	3.16 ± 0.05
131	2.81 ± 0.08	3.29 ± 0.06	022	2.85 ± 0.04	3.08 ± 0.05
201	3.18 ± 0.03	2.93 ± 0.01	032	2.83 ± 0.06	2.83 ± 0.03
212	3.08 ± 0.05	3.12 ± 0.10	131	2.94 ±0.07	3.24 ± 0.05
222	2.96 ± 0.06	3.27 ± 0.11	202	3.01 ± 0.07	3.16 ± 0.03
230	2.78 ± 0.04	2.97 ± 0.09	211	2.93 ± 0.04	3.13 ± 0.07
231	2.98 ± 0.07	3.30 ± 0.15	212	3.01 ± 0.03	3.18 ± 0.02
303	2.85 ± 0.04	3.23 ± 0.07	231	2.90 ± 0.08	3.20 ± 0.04
312	2.95 ± 0.04	3.17 ± 0.08	233	3.03 ± 0.05	3.20 ± 0.05
332	3.29 ± 0.07	3.39 ± 0.04	312	3.20 ± 0.01	3.41 ± 3.02
333	3.07 ± 0.05	3.29 ± 0.10	332	3.18 ± 0.04	3.35 ± 0.06
Mean	2.98 ± 0.03	3.15 ± 0.03	Mean	2.97 ± 0.02	3.16 ± 0.03
%CV	5.00	6.00	%CV	5.00	5.00
LSD 5%	0.08	0.10	LSD 5%	0.06	0.06
1%	0.11	0.14	1%	0.08	0.08

Table 4. 3. 4. Leaf N (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site-3.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	2.84 ± 0.07	3.00 ± 0.05	000	2.91 ± 0.06	2.80 ± 0.06
011	2.95 ± 0.06	3.07 ± 0.04	010	2.89 ± 0.08	3.26 ± 0.07
023	2.70 ± 0.14	2.86 ± 0.07	021	2.80 ± 0.07	3.06 ± 0.07
100	2.75 ± 0.04	3.35 ± 0.13	100	2.88 ± 0.08	3.15 ± 0.03
110	2.87 ± 0.29	3.43 ± 0.17	103	2.76 ± 0.06	3.17 ± 0.14
111	3.01 ± 0.06	3.30 ± 0.04	121	2.93 ± 0.03	3.16 ± 0.13
203	3.15 ± 0.22	3.47 ± 0.15	132	2.85 ± 0.04	3.31 ± 0.06
210	2.84 ± 0.06	3.29 ± 0.07	211	2.99 ± 0.05	3.24 ± 0.10
220	2.91 ± 0.08	3.08 ± 0.09	222	2.85 ± 0.04	3.09 ± 0.11
300	3.07 ± 0.08	3.17 ± 0.06	223	3.03 ± 0.03	3.18 ± 0.09
301	3.07 ± 0.09	3.18 ± 0.13	230	2.90 ± 0.04	3.14 ± 0.05
302	3.32 ± 0.33	3.33 ± 0.04	302	2.99 ± 0.06	3.08 ± 0.09
311	3.06 ± 0.04	3.19 ± 0.07	311	3.26 ± 0.11	2.90 ± 0.10
Mean	2.97 ± 0.04	3.21 ± 0.04	Mean	2.92 ± 0.02	3.12 ± 0.03
%CV	9.00	8.00	%CV	5.00	6.00
LSD 5%	0.21	0.19	LSD 5%	0.08	0.12
1%	0.28	0.25	1%	0.11	0.17

Table 4. 3. 5. Leaf P (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site-1.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	0.19 ± 0.01	0.20 ± 0.01	000	0.21 ± 0.01	0.21 ± 0.02
012	0.20 ± 0.01	0.26 ± 0.03	012	0.19 ± 0.01	0.22 ± 0.01
021	0.21 ± 0.02	0.28 ± 0.03	030	0.22 ± 0.01	0.28 ± 0.02
030	0.19 ± 0.02	0.21 ± 0.01	032	0.26 ± 0.01	0.29 ± 0.02
100	0.22 ± 0.02	0.22 ± 0.01	102	0.20 ± 0.01	0.23 ± 0.01
121	0.22 ± 0.01	0.26 ± 0.01	120	0.22 ± 0.01	0.27 ± 0.03
123	0.21 ± 0.02	0.24 ± 0.02	121	0.23 ± 0.02	0.28 ± 0.02
211	0.17 ± 0.03	0.22 ± 0.01	122	0.29 ± 0.02	0.33 ± 0.02
231	0.24 ± 0.03	0.26 ± 0.01	201	0.21 ± 0.01	0.23 ± 0.02
312	0.20 ± 0.02	0.21 ± 0.03	202	0.21 ± 0.01	0.26 ± 0.02
313	0.22 ± 0.01	0.24 ± 0.03	313	0.25 ± 0.02	0.29 ± 0.01
321	0.26 ± 0.03	0.29 ± 0.02	321	0.22 ± 0.01	0.26 ± 0.01
322	0.22 ± 0.01	0.25 ± 0.02	322	0.28 ±0 .02	0.31 ± 0.03
Mean	0.21 ± 0.01	0.24 ± 0.01	Mean	0.23 ± 0.01	0.27 ± 0.01
%CV	19.00	17.00	%CV	17.00	19.00
LSD 5%	0.02	0.02	LSD 5%	0.02	0.02
1%	0.02	0.02	1%	0.03	0.03

Table 4. 3. 6. Leaf P (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site 2.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	0.20 ± 0.01	0.19 ± 0.02	000	0.19 + 0.01	0.23 ± 0.02
031	0.22 ± 0.02	0.28 ± 0.02	003	0.26 ± 0.03	0.21 ± 0.02
113	0.21 ± 0.02	0.21 ± 0.01	020	0.18 ± 0.01	0.22 ± 0.01
131	0.21 ± 0.09	0.24 ± 0.02	022	0.19 ± 0.02	0.22 ± 0.02
201	0.21 ± 0.02	0.23 ± 0.01	032	0.19 ± 0.01	0.22 ± 0.01
212	0.24 ± 0.02	0.21 ± 0.01	131	0.22 ± 0.02	0.27 ± 0.03
222	0.23 ± 0.02	0.25 ± 0.19	202	0.23 ± 0.01	0.25 ± 0.02
230	0.20 ± 0.02	0.25 ± 0.02	211	0.21 ± 0.01	0.24 ± 0.02
231	0.22 ± 0.02	0.29 ± 0.03	212	0.20 ± 0.02	0.24 ± 0.02
303	0.22 ± 0.09	0.26 ± 0.09	231	0.22 ± 0.02	0.25 ± 0.02
312	0.19 ± 0.02	0.22 ± 0.02	233	0.22 ± 0.01	0.26 ± 0.01
332	0.19 ± 0.02	0.22 ± 0.09	312	0.21 ± 0.02	0.25 ± 0.03
333	0.2 ± 0.01	0.26 ± 0.01	332	0.21 ± 0.01	0.24 ± 0.02
Mean	0.21 ± 0.05	0.24 ± 0.06	Mean	0.21 ± 0.0 1	0.24 ± 0.01
%CV	14.00	17.00	%CV	14.00	13.00
LSD 5%	0.02	0.02	LSD 5%	0.02	0.02
1%	0.03	0.03	1%	0.03	0.03

Table 4. 3. 7. Leaf P (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site 3.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	0.23 ± 0.01	0.24 ± 0.01	000	0.22 ± 0.01	0.20 ± 0.02
011	0.27 ± 0.02	0.26 ± 0.03	010	0.20 ± 0.01	0.19 ± 0.01
023	0.25 ± 0.02	0.30 ± 0.09	021	0.20 ± 0.01	0.29 ± 0.02
100	0.25 ± 0.01	0.24 ± 0.02	100	0.17 ± 0.01	0.20 ± 0.01
110	0.24 ± 0.02	0.25 ± 0.01	103	0.24 ± 0.02	0.23 ± 0.01
111	0.27 ± 0.01	0.25 ± 0.02	121	0.22 ± 0.02	0.30 ±0.01
203	0.23 ± 0.01	0.27 ± 0.02	132	0.25 ± 0.01	0.30 ± 0.01
210	0.23 ± 0.01	0.30 ± 0.01	211	0.22 ± 0.02	0.25 ± 0.01
220	0.24 ± 0.01	0.31 ± 0.01	222	0.23 ± 0.02	0.26 ± 0.01
300	0.19 ± 0.01	0.24 ± 0.02	223	0.21 ± 0.01	0.30 ± 0.01
301	0.25 ± 0.01	0.19 ± 0.01	230	0.24 ± 0.01	0.26 ± 0.01
302	0.25 ± 0.01	0.22 ± 0.02	302	0.22 ± 0.01	0.24 ± 0.02
311	0.23 ± 0.01	0.24 ± 0.01	311	0.20 ± 0.01	0.23 ± 0.01
Mean	0.24 ± 0.01	0.25 ± 0.01	Mean	0.22 ± 0.01	0.25 ± 0.01
%CV	13.00	16..00	%CV	14.00	16..00
LSD 5%	0.02	0.02	LSD 5%	0.02	0.19
1%	0.03	0.03	1%	0.03	0.25

Table 4. 3. 8. Leaf K (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site-1.

NPK	Dec. '94	Sep. '95	NPK	Dec. '95	Sep. '96
Level	after 90 days	after one year	Level	after 90 days	after one year
000	0.97 ± 0.07	1.05 ± 0.04	000	1.00 ± 0.08	1.08 ± 0.08
012	1.11 ± 0.12	1.15 ± 0.18	012	1.00 ± 0.07	1.13 ± 0.07
021	0.96 ± 0.18	1.36 ± 0.18	030	1.01 ± 0.05	1.13 ± 0.05
030	0.81 ± 0.04	1.18 ± 0.06	032	0.99 ± 0.10	1.10 ± 0.05
100	0.96 ± 0.21	1.04 ± 0.13	102	0.84 ± 0.16	0.96 ± 0.16
121	0.99 ± 0.15	1.16 ± 0.07	120	1.15 ± 0.09	1.25 ± 0.06
123	0.70 ± 0.02	1.23 ± 0.00	121	0.86 ± 0.08	0.99 ± 0.09
211	0.96 ± 0.16	1.38 ± 0.25	122	0.88 ± 0.06	1.03 ± 0.04
231	0.82 ± 0.11	1.26 ± 0.07	201	0.92 ± 0.05	1.04 ± 0.05
312	1.01 ± 0.14	1.04 ± 0.15	202	0.96 ± 0.12	1.10 ± 0.08
313	1.34 ± 0.11	1.32 ± 0.19	313	0.97 ± 0.15	1.11 ± 0.11
321	0.90 ± 0.13	1.18 ± 0.12	321	1.04 ± 0.04	1.15 ± 0.04
322	0.92 ± 0.15	1.33 ± 0.11	322	1.06 ± 0.17	1.19 ± 0.14
Mean	0.96 ± 0.04	1.21 ± 0.04	Mean	0.98 ± 0.03	1.10 ± 0.02
%CV	25.00	19.00	%CV	17.00	14.00
LSD 5%	0.18	0.18	LSD 5%	0.14	0.12
1%	0.25	0.25	1%	0.19	0.17

Table 4. 3. 9. Leaf K (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site 2.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	1.07 ± 0.04	0.84 ± 0.03	000	0.93 ± 0.03	0.93 ± 0.04
031	1.12 ± 0.03	0.95 ± 0.05	003	1.07 ± 0.10	1.02 ± 0.05
113	1.31 ± 0.05	0.93 ± 0.03	020	0.98 ± 0.14	0.95 ± 0.02
131	1.28 ± 0.07	0.96 ± 0.13	022	0.96 ± 0.10	1.06 ± 0.07
201	1.31 ± 0.07	1.10 ± 0.08	032	0.91 ± 0.06	0.91 ± 0.06
212	1.05 ± 0.05	0.87 ± 0.05	131	1.10 ± 0.10	0.89 ± 0.03
222	1.15 ± 0.06	1.28 ± 0.03	202	1.24 ± 0.09	1.03 ± 0.04
230	1.09 ± 0.04	0.93 ± 0.02	211	1.04 ± 0.05	0.93 ± 0.03
231	1.25 ± 0.03	1.25 ± 0.07	212	1.11 ± 0.09	0.96 ± 0.04
303	1.30 ± 0.09	0.92 ± 0.09	231	1.23 ± 0.09	0.92 ± 0.04
312	0.96 ± 0.05	1.17 ± 0.09	233	1.16 ± 0.04	1.05 ± 0.04
332	1.32 ± 0.09	0.97 ± 0.06	312	1.05 ± 0.09	1.06 ± 0.04
333	1.36 ± 0.05	1.03 ± 0.04	332	1.17 ± 0.05	1.18 ± 0.04
Mean	1.20 ± 0.02	1.02 ± 0.03	Mean	1.07 ± 0.03	0.99 ± 0.02
%CV	13.00	12.00	%CV	15.00	9.00
LSD 5%	0.08	0.08	LSD 5%	0.12	0.04
1%	0.11	0.11	1%	0.17	0.05

Table 4. 3. 10. Leaf K (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site-3.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	0.93 ± 0.04	0.87 ± 0.06	000	1.00 ± 0.07	1.12 ± 0.03
011	1.39 ± 0.04	1.30 ± 0.04	010	0.94 ± 0.02	0.87 ± 0.04
023	1.35 ± 0.06	1.27 ± 0.04	021	1.22 ± 0.06	0.93 ± 0.01
100	1.23 ± 0.08	0.99 ± 0.03	100	0.92 ± 0.05	1.16 ± 0.05
110	1.17 ± 0.03	1.09 ± 0.03	103	1.11 ± 0.10	1.32 ± 0.03
111	1.19 ± 0.01	1.02 ± 0.05	121	1.35 ± 0.06	0.94 ± 0.01
203	1.21 ± 0.04	0.94 ± 0.08	132	1.01 ± 0.04	1.27 ± 0.08
210	1.12 ± 0.08	0.94 ± 0.12	211	1.11 ± 0.09	0.87 ± 0.02
220	1.02 ± 0.04	1.19 ± 0.13	222	0.92 ± 0.12	1.22 ± 0.011
300	0.91 ± 0.07	1.19 ± 0.04	223	1.37 ± 0.07	1.20 ± 0.02
301	1.29 ± 0.02	0.90 ± 0.05	230	1.15 ± 0.09	1.00 ± 0.10
302	1.13 ± 0.04	1.28 ± 0.08	302	1.08 ± 0.09	1.13 ± 0.04
311	1.38 ± 0.05	1.22 ± 0.05	311	1.08 ± 0.08	0.94 ± 0.02
Mean	1.18 ± 0.03	1.09 ± 0.03	Mean	1.10 ± 0.03	1.08 ± 0.03
%CV	14.00	17..00	%CV	16..00	16..00
LSD 5%	0.06	0.10	LSD 5%	0.06	0.08
1%	0.08	0.14	1%	0.08	0.11

Phosphorus

Table 4. 3. 5 presents data of total leaf P contents in site-1 at four different sampling periods: December '94, September '95, December '95 and September '96. The mean values of leaf P were 0.21% and 0.24% in December '94 and September '95 respectively. Similar values of P concentration were found in the following year. Coefficients of variation were between 17 and 19%. Mean values of leaf P in site-2 were 0.21% in December and 0.24 % in September of both years (Table 4. 3. 6). Coefficients of variation were between 13 and 17%. Table 4. 3. 7 shows P contents of leaf in site-3. The mean values for December '94, September '95, December '95 and September '96 were 0.24%, 0.25 %, 0.22% and 0.25% respectively. Coefficients of variation were 13 to 16% during these sampling periods.

Potassium

The mean values of leaf K in site-1 were found 0.96% in December '94 and 1.21% in - September '95 (Table 4. 3. 8). In the following year there were 0.98% in December '95 and 1.10% in September '96. Coefficient of variation was 25% in December '94 and 19% in September '95. The values varied at a lower rate in the second year. In site-2 mean K contents were 1.20% and 1.02% in December '94 and- September '95 respectively with coefficients of variation of 12 to 13% (Table 4. 3. 9). The K values in corresponding months of the following year were 1.07% and 0.99%. Table 4. 3. 10 shows K contents in site-3. The mean values of K content for December '94, September '95, December '95 and September '96 were 1.18%, 1.09 %, 1.10% and 1.08 % respectively. Coefficients of variation were around 14% to 17%. So, the three sites had almost similar values of leaf K.

Calcium

Table 4. 3. 11 contains data of leaf Ca in site-1 at four different sampling periods: December '94, September '95, December '95 and September '96 with the corresponding mean values of 1.31%, 1.03%, 1.31% and 1.08%. Thus there was generally higher leaf Ca concentration in December. Coefficients of variation were 15 to 22%. In site-2, mean Ca contents in leaf were 1.46% in December '94, 1.16% in September '95, 1.58% in December '95, and 1.38% in September '96 (Table 4. 3. 12). Coefficients of variation of Ca were 20% and 18% in December '94 and September '95 respectively while in the

second year it was only 8%. Leaf Ca contents in site-3 are presented in Table 4. 3. 13. The mean values of Ca content for were found 1.35% and 1.19% in December '94 and September '95 respectively. Ca concentration was found 1.48% and 1.32% in December '95 and September '96. Coefficients of variation were 12% to 14% in the first year and 8% in the second year.

Magnesium

Mg contents in leaf in site-1 as presented in Table 4. 3. 14 show mean values of 0.48% and 0.52% in December '94 and September '95 respectively. The corresponding months in the next year had 0.45% and 0.47%. Coefficients of variation were 21% in December '94 and 17% in September '95. In the second year, CV values were 11% and 17%. Table 4. 3. 15 contains Mg contents of leaf in site-2 during December '94, September '95, December '95 and September '96. The mean values of these respective periods were 0.56 %, 0.47 %, 0.61% and 0.55%. Coefficients of variation were 21% in December '94 and 19% in September '95. In December '95 and September '96, CV values were 10% and 16%. Table 4. 3. 16 presents Mg contents of leaf in site-3. During December '94, September '95, December '95 and September '96, the mean values of Mg were 0.59%, 0.61%, 0.60% and 0.63% with the respective coefficients of variation of 14%, 12%, 13% and 10%.

4. 3. 2. 2. Variation due to treatments

Variation due to fertilizer treatments was evaluated from analyses of variance. The F values are presented in Table 4. 3. 17 and the details of ANOVA are given in Appendices XXXV – XL. There were significant differences in foliar N during December, 94 and in P during December, 94 and September, 96 among the fertilizer treatments included in site-1. In this site, leaf K, Ca and Mg did not vary significantly with treatments. However, in site-2, leaf N varied significantly among the treatments in all sampling periods. There were also significant variation in leak K except in December, 95, in Ca during September, 95 and December, 95. Leaf Mg differed with treatments only during December, 95. In site-3, leaf N varied due to treatments in December, 95 and September, 96 but P did so in September of both the years. Differences in leaf K among treatments were significant at all sampling periods, in leaf Ca only in the second year and in Mg during all periods except December, 94.

Table 4.3.11. Leaf Ca (%)contents (mean ± SE) after 90 days and 1 year of fertilizer application in site 1.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	1.53 ± 0.27	1.08±0.08	000	1.27 ± 0.12	0.97 ± 0.12
012	1.30 ± 0.27	1.16 ± 0.07	012	1.28 ± 0.03	1.04 ± 0.05
021	1.16 ± 0.05	1.10 ± 0.05	030	1.14 ± 0.06	0.95 ± 0.09
030	1.32 ± 0.09	1.02 ± 0.03	032	1.49±0.02	1.16 ± 0.11
100	0.94 ± 0.11	0.97 ± 0.07	102	1.36 ± 0.18	1.14 ± 0.14
121	1.45 ± 0.16	1.01 ± 0.10	120	1.35 ± 0.24	1.03 ± 0.14
123	1.50 ± 0.06	0.95 ± 0.10	121	1.28 ± 0.22	1.02 ± 0.14
211	1.42 ± 0.22	1.13 ± 0.12	122	1.42 ± 0.09	1.15 ± 0.04
231	1.34 ± 0.08	1.11 ± 0.13	201	1.36 ± 0.19	1.11 ± 0.15
312	1.19 ± 0.16	0.99 ± 0.06	202	1.36±0.02	1.20 ± 0.13
313	1.17 ± 0.17	0.98 ± 0.15	313	1.08 ± 0.45	1.35 ± 0.09
321	1.35 ± 0.22	0.99 ± 0.11	321	1.33 ± 0.15	0.91 ± 0.03
322	1.34 ± 0.12	0.88 ± 0.02	322	1.37 ± 0.17	1.06 ± 0.14
Mean	1.31 ± 0.05	1.03 ± 0.02	Mean	1.31 ± 0.12	1.08 ± 0.03
%CV	22.00	15.00	%CV	22.00	19.00
LSD 5%	0.23	0.12	LSD 5%	0.25	0.16
1%	0.31	0.17	1%	0.33	0.22

Table 4. 3. 12. Leaf Ca (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site-2.

NPK	Dec. '94	Sep. '95	NPK	Dec. '95	Sep. '96
Level	after 90 days	after one year	Level	after 90 days	after one year
000	1.63 ± 0.04	1.42 ± 0.06	000	1.36 ± 0.04	1.28 ± 0.05
031	1.44 ± 0.08	1.08 ± 0.04	003	1.66 ± 0.09	1.38 ± 0.03
113	1.46 ± 0.05	1.20 ± 0.01	020	1.63 ± 0.13	1.32 ± 0.07
131	1.36 ± 0.09	1.03 ± 0.02	022	1.49 ± 0.03	1.34 ± 0.05
201	1.50 ± 0.13	1.02 ± 0.09	032	1.55 ± 0.15	1.45 ± 0.12
212	1.41 ± 0.05	1.24 ± 0.04	131	1.66 ± 0.06	1.44 ± 0.06
222	1.49 ± 0.08	1.07 ± 0.09	202	1.46 ± 0.09	1.33 ± 0.06
230	1.29 ± 0.05	1.00 ± 0.02	211	1.68 ± 0.08	1.40 ± 0.07
231	1.31 ± 0.06	0.93 ± 0.07	212	1.57 ± 0.07	1.41 ± 0.07
303	1.53 ± 0.10	1.31 ± 0.06	231	1.60 ± 0.01	1.46 ± 0.06
312	1.82 ± 0.49	1.35 ± 0.06	233	1.70 ± 0.04	1.43 ± 0.03
332	1.33 ± 0.25	1.30 ± 0.28	312	1.59 ± 0.01	1.39 ± 0.02
333	1.44 ± 0.23	1.16 ± 0.10	332	1.63 ± 0.14	1.33 ± 0.10
Mean	1.46 ± 0.05	1.16 ± 0.03	Mean	1.58 ± 0.03	1.38 ± 0.03
%CV	20.00	18.00	%CV	8.00	8.00
LSD 5%	0.08	0.14	LSD 5%	0.06	0.08
1%	0.11	0.19	1%	0.08	0.11

Table 4. 3. 13. Leaf Ca (%)contents (mean ± SE) after 90 days and 1 year of fertilizer application in site-3.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	1.36 ± 0.01	1.14 ± 0.07	000	1.46 ± 0.06	1.19 ± 0.04
011	1.19 ± 0.14	1.03 ± 0.06	010	1.43 ± 0.09	1.30 ± 0.08
023	1.32 ± 0.09	1.09 ± 0.13	021	1.45 ± 0.05	1.36 ± 0.03
100	1.44 ± 0.09	1.17 ± 0.11	100	1.59 ± 0.05	1.19 ± 0.07
110	1.40 ± 0.01	1.29 ± 0.09	103	1.49 ± 0.12	1.37 ± 0.10
111	1.34 ± 0.12	1.28 ± 0.08	121	1.38 ± 0.15	1.24 ± 0.09
203	1.24 ± 0.12	1.24 ± 0.02	132	1.56 ± 0.04	1.43 ± 0.07
210	1.37 ± 0.12	1.05 ± 0.12	211	1.46 ± 0.07	1.29 ± 0.04
220	1.49 ± 0.03	1.19 ± 0.03	222	1.51 ± 0.04	1.36 ± 0.04
300	1.42 ± 0.07	1.35 ± 0.07	223	1.63 ± 0.11	1.25 ± 0.05
301	1.40 ± 0.05	1.38 ± 0.05	230	1.62 ± 0.08	1.47 ± 0.06
302	1.43 ± 0.04	1.29 ± 0.10	302	1.33 ± 0.12	1.38 ± 0.06
311	1.13 ± 0.06	1.02 ± 0.11	311	1.29 ± 0.10	1.27 ± 0.05
Mean	1.35 ± 0.03	1.19 ± 0.03	Mean	1.48 ± 0.03	1.32 ± 0.03
%CV	12.00	14.00	%CV	8.00	8.00
LSD 5%	0.12	0.12	LSD 5%	0.06	0.06
1%	0.17	0.17	1%	0.08	0.08

Table 4. 3. 14. Leaf Mg (%)contents (mean ± SE) after 90 days and 1 year of fertilizer application in site 1.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	0.47 ± 0.05	0.57 ± 0.07	000	0.47 ± 0.03	0.56 ± 0.03
012	0.49 ± 0.11	0.54 ± 0.03	012	0.39 ± .04	047 ± 0.04
021	0.54 ± 0.07	0.51 ± 0.08	030	0.43 ± 0.04	0.45 ± 0 .05
030	0.51 ± 0.05	0.52 ± 0.08	032	0.47 ± 0.05	0.45 ± 0.05
100	0.41 ± 0.04	0.57 ± 0.05	102	0.43 ± 0.06	0.53 ± 0.06
121	0.41 ± 0.01	0.50 ± 0.01	120	0.42 ± 0.02	0.41 ± 0.01
123	0.56 ± 0.06	0.49 ± 0.04	121	0.47 ± 0.06	0.46 ± 0.04
211	0.44 ± 0.03	0.58 ± 0.10	122	0.43 ± 0.02	0.52 ± 0.06
231	0.50 ± 0.01	0.53 ± 0.05	201	0.49 ± 0.03	0.46 ± 0.03
312	0.52 ± 0.03	0.52 ± 0.05	202	0.41 ± 0.06	0.42 ± 0.06
313	0.44 ± 0.06	0.47 ± 0.05	313	0.43 ± 0.04	0.57 ± 0.04
321	0.47 ± 0.09	0.49 ± 0.06	321	0.47 ± 0.03	0.42 ± 0.02
322	0.49 ± 0.07	0.45 ± 0.05	322	0.49 ± 0.02	0.43 ± 0.03
Mean	0.48 ± 0.02	0.52 ± 0.01	Mean	0.45 ± 0.01	0.47 ± 0.01
%CV	21.00	17.00	%CV	11.00	17.00
LSD 5%	0.08	0.08	LSD 5%	0.04	0.06
1%	0.11	0.11	1%	0.06	0.06

Table 4. 3. 15. Leaf Mg (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site-2.

NPK Level	Dec. '94	Sep. '95	NPK Level	Dec. '95	Sep. '96
	after 90 days	after one year		after 90 days	after one year
000	0.62 ± 0.09	0.53 ± 0.06	000	0.61 ± 0.04	0.49 ± 0.03
031	0.51 ± 0.06	0.44 ± 0.05	003	0.65 ± 0.12	0.63 ± 0.06
113	0.59 ± 0.04	0.51 ± 0.04	020	0.59 ± 0.07	0.61 ± 0.03
131	0.52 ± 0.03	0.46 ± 0.04	022	0.55 ± 0.03	0.47 ± 0.03
201	0.50 ± 0.04	0.38 ± 0.05	032	0.61 ± 0.07	0.64 ± 0.07
212	0.68 ± 0.08	0.60 ± 0.07	131	0.52 ± 0.02	0.58 ± 0.02
222	0.55±0.04	0.48 ± 0.01	202	0.68 ± 0.03	0.48 ± 0.05
230	0.61 ± 0.05	0.43 ± 0.05	211	0.62 ± 0.05	0.54 ± 0.03
231	0.56 ± 0.08	0.48 ± 0.08	212	0.64 ± 0.08	0.48 ± 0.03
303	0.57 ± 0.04	0.50 ± 0.09	231	0.58 ± 0.04	0.56 ± 0.06
312	0.57 ± 0.03	0.49 ± 0.01	233	0.63 ± 0.07	0.58 ± 0.07
332	0.61 ± 0.09	0.45 ± 0.04	312	0.68 ± 0.05	0.65 ± 0.05
333	0.42 ± 0.16	0.42 ± 0.03	332	0.56 ± 0.04	0.49 ± 0.04
Mean	0.56 ± 0.02	0.47 ± 0.01	Mean	0.61 ± 0.02	0.55 ± 0.01
%CV	21.00	19.00	%CV	10.00	16.00
LSD 5%	0.10	0.06	LSD 5%	0.04	0.06
1%	0.14	0.08	1%	0.06	0.08

Table 4. 3. 16. Leaf Mg (%) contents (mean ± SE) after 90 days and 1 year of fertilizer application in site-3.

NPK Level	Dec. '94 after 90 days	Sep. '95 after one year	NPK Level	Dec. '95 after 90 days	Sep. '96 after one year
000	0.52 ± 0.04	0.54 ± 0.05	000	0.47 ± 0.03	0.54 ± 0.05
011	0.50 ± 0.05	0.58 ± 0.04	010	0.49 ± 0.04	0.61 ± 0.07
023	0.59 ± 0.05	0.61 ± 0.02	021	0.57 ± 0.02	0.65 ± 0.15
100	0.54 ± 0.08	0.61 ± 0.06	100	0.67 ± 0.05	0.66 ± 0.02
110	0.64 ± 0.05	0.55 ± 0.06	103	0.65 ± 0.03	0.57 ± 0.06
111	0.63 ± 0.04	0.65 ± 0.06	121	0.54 ± 0.04	0.59 ± 0.08
203	0.55 ± 0.05	0.55 ± 0.05	132	0.65 ± 0.02	0.63 ± 0.09
210	0.58 ± 0.04	0.59 ± 0.02	211	0.61 ± 0.04	0.63 ± 0.06
220	0.67 ± 0.06	0.65 ± 0.07	222	0.68 ± 0.02	0.70 ± 0.04
300	0.57 ± 0.03	0.67 ± 0.04	223	0.54 ± 0.03	0.67 ± 0.09
301	0.60 ± 0.04	0.56 ± 0.01	230	0.67 ± 0.06	0.68 ± 0.01
302	0.62 ± 0.06	0.66 ± 0.05	302	0.66 + 0.04	0.62 ± 0.01
311	0.61 ± 0.09	0.71 ± 0.05	311	0.64 ± 0.06	0.66 ± 0.06
Mean	0.59 ± 0.02	0.61± 0.02	Mean	0..60 ± 0.01	0.63 ± 0.02
%CV	14.00	12.00	%CV	13..00	10.00
LSD 5%	0.06	0.02	LSD 5%	0.04	0.04
1%	0.08	0.06	1%	0.06	0.06

Thus, leaf N, P and K were generally higher in treatments other than control. On the other hand, Ca and Mg did not differ appreciably between the treatments and the control. However, Pushpadas *et al.* (1973) concluded that application of N, P and K fertilizers had no effect on N, P, K, Ca and Mg concentration of leaf. There was no correlation with these nutrients in soil and leaf.

4. 3. 2. 3. Variation due to sampling period

Variation in leaf nutrient concentrations due to sampling period was estimated from paired sample t-tests (Appendices XLI – XLVI). The t-values are presented in Table 4. 3. 18. Foliar N and P values were in most cases higher during September than December, so that t values were negative for these two nutrients at all instances. The differences were statistically significant except between December, 95 and September, 96 for N in site-1 and between December, 94 and September, 95 for P in site-3. For leaf K, however, higher values were observed in September in site-1 but lower in other sites. Leaf Ca values of December were higher than those of September in all sites and in both years of study. So, all t-values for leaf Ca were positive and significant. Leaf Mg values of site-2 differed significantly between December and September, the later having lower values. In site-3, significant negative t-value was obtained between December and September of the second year. The t-values for leaf Mg in site-1 were also negative but not significant.

There are many factors that influence the leaf nutrient contents. These include leaf position, rootstock, scion-clone relation, crown-clone interaction, time of sampling, seasonal effects etc. Sivanadyan (1980) suggested considering these factors at the time of interpretation of leaf analysis data. Shorrocks (1964) observed that nutrient concentration changes with leaf age. He suggested the leaf sampling of similar age and critical age of leaf should be 100 days after fertilizer application. On the other hand, Sivanadyan (1980) recommended sampling of leaf in mature rubber at least 70 days after fertilizer application. Keli and Omont (1990) collected and analyzed leaf samples of *H. brasiliensis* on a monthly basis. They found that NPK contents decreased and Ca contents increased with physiological age. Guha and Narayanan (1969) reported almost similar results. In the present study, leaf samples were taken almost uniformly from each plot at a definite time of the year.

Table 4. 3. 17. F-values for foliar nutrients due to fertilizer treatments.

Site	Sampling time	N	P	K	Ca	Mg
1	December, 94	3.84**	1.40 ns	1.34 ns	0.92 ns	0.59 ns
	September, 95	1.51 ns	1.86 ns	0.74 ns	0.78 ns	0.49 ns
	December, 95	0.67 ns	3.93**	0.74 ns	0.36 ns	1.48 ns
	September, 96	1.12 ns	3.47**	0.84 ns	1.08 ns	1.61 ns
2	December, 94	7.30***	0.68 ns	5.04***	0.64 ns	0.81 ns
	September, 95	3.66**	3.33**	4.77***	2.49*	1.35 ns
	December, 95	5.36***	1.35 ns	1.65 ns	4.26***	3.62**
	September, 96	11.49***	0.79 ns	8.50***	1.05 ns	2.10 ns
3	December, 94	1.29 ns	1.91 ns	9.69***	1.50 ns	1.19 ns
	September, 95	1.64 ns	4.21***	4.99***	2.01 ns	2.55*
	December, 95	4.03***	1.87 ns	3.56**	5.66***	6.08**
	September, 96	2.54*	8.91***	8.31***	3.32**	2.75*

*Significant at 5%, **significant at 1%, ***significant at 0.1% levels; ns= not significant.

Table 4. 3. 18. Paired sample t values for foliar nutrients due to fertilizer treatments.

Site	Pairs	N	P	K	Ca	Mg
1	Dec. 94 – Sept. 95	- 8.31***	- 4.74***	- 4.91***	5.66***	- 1.69 ns
	Dec. 95 – Sept. 96	- 0.66 ns	- 8.79***	- 15.10***	4.92***	-1.95 ns
2	Dec. 94 – Sept. 95	- 4.55***	- 4.47***	5.06***	5.36***	8.30***
	Dec. 95 – Sept. 96	- 9.34***	- 6.36***	2.91 ***	10.14***	3.54***
3	Dec. 94 – Sept. 95	- 4.10***	- 1.34 ns	2.52*	6.02***	-1.59 ns
	Dec. 95 – Sept. 96	- 4.71***	- 4.21***	0.54 ns	6.66***	- 2.28*

*Significant at 5%, **significant at 1%, ***significant at 0.1% levels; ns= not significant.

The periods of sampling were 90 days and 1 year after fertilizer application. So, variation due to factors other than soil and tree status and period of sampling should be minimal. As Noor (1988) found that generally higher levels of nutrients are observed in leaves of the shaded canopy because of their greater sensitivity to nutritional changes than leaves in open light, sampling pattern of the present study followed to represent an average of both type exposure. Since, a uniform procedure of sampling was followed, the variation in foliar nutrients should depend on fertilizer treatments, tree vigour and soil nutrient supply. It has already been mentioned above that only leaf N varied significantly among treatments and from control but there was no significant difference in other nutrients of the foliage.

According to Punnoose *et al.* (1975), low values were <3.00% N, <0.25% P and <1.00 K; medium values were 3.00-3.20%N, 0.20-0.25% P and 1.00-1.20% K while high values were >3.20% N, >0.25% P and >1.20% K for *Hevea*. Wong (1988) reported the range of leaf nutrient content at optimum age in the shaded canopy for different clones. He classified the concentration of N, P, K, Mg and Mn as low, medium high and very high for some the specified species. There low to high range were <3.3-3.91% for N, 0.19-0.28% for P, 1.35-1.86% for K and 0.19-0.30% for Mg and 45 -151 ppm for Mn in RRIM-600 and GT-1 clones. From studies on ten years of fertilizer experiments on rubber, Lu and He (1982) suggested 3.2-3.4% N, 0.21- 0.23% P, 0.90-1.1% K, 0.6-1.00 % Ca and 0.35-0.45% Mg as the critical nutrient values for healthy latex yielding trees. In this context, most values of foliar N, P, K, Ca and Mg of the present study were above the critical levels. Many workers (Owen 1953, RRIM 1965, Guha and Pushparajah 1966 and Chan 1971) concluded that annual mean yield showed an effect of P application where the leaf P concentration was low to medium. They also reported that response to P application is likely only in cases where the leaf P status is low. Bataglia *et al.* (1988) assessed the leaf and soil samples from the 40 rubber plantations in the Atlantic Coastal belt. Afterwards they concluded that leaf N and K concentration were associated with production of latex.

4. 4. Latex Production

Latex yield data of the three of sites have been recorded month wise from plots of each treatment during October '94 to September '96 (Appendices XLVII - LXIV). There was month wise variation in production of latex. The trend of variation is shown between Fig. 4. 4. 1 and 4. 4. 6. It was noticed that there was considerably low yield during the months of January to April, while higher production was recorded during September to December and May to August. Also considerably higher latex yield was found at all months in the second year of study. Mean values are presented in Tables 4. 4. 1 to 4. 4. 3.

4. 4. 1. Site-1

In the control plot ($N_0P_0K_0$) produced 50.86 cc in the first year, 63.15 cc in the second year with an average of 56.98 cc/tree/tap (Table 4. 4. 1). The average yield in the control was 2133.33 kg/ha/yr. In the first year, the minimum latex yield (44.41 cc/tree/tap) was obtained in treatment $N_3P_3K_1$ and the maximum (77.24 cc/tree/tap) in treatment $N_3P_2K_2$. In the second year the lowest (53.37 cc/tree/tap) and the highest yield (101.07 cc/tree/tap) were found respectively in treatments $N_3P_3K_1$ and N_3P_2 K_1. Minimum and maximum average latex yield of two years were 52.14 cc in N_2 P_1 K_0 and 86.70 cc /tree/tap in N_3 P_2K_2 treatments respectively. Coefficient of variation in latex yield among the 64 treatments was about 18%. The highest average yield per hectare was 3246.05 kg/yr in treatment $N_3P_2K_2$ and the least was 1779.52 kg/yr in treatment $N_3P_2K_0$.

4. 4. 2. Site-2

Table 4. 4. 2 contains average latex yield data for different treatments in site-2. Mean average yield of latex for the two years was 65.43 cc/tree/tap. On an average minimum and maximum latex yields were 52.95 and 79.76 cc/tree/tap respectively in treatments $N_2P_1K_0$ and $N_2P_2K_1$. In the first and the second year, average yields were 59.68 and 71.16 cc/tree/tap respectively. The lowest and the highest values during first year were 43.81 and 74.71 cc/tree/tap were obtained respectively in treatments $N_2P_1K_3$ and $N_2P_1K_2$. In the second year the minimum (56.97 cc) and the maximum (86.20 cc/tree/tap) values were found in treatments $N_2P_2K_1$ and N_3P_3K $_2$ respectively. On hectare basis yield of latex varied from 1942.01 kg/yr in treatment $N_2P_1K_3$ to 2986.21 kg/yr in treatment $N_2P_1K_2$. The control plots had 2115.73 kg/ha/yr.

Table 4. 4. 1. Latex production under different fertilizer treatments in site-1.

SL No.	Treatment	Yield (cc/tree/tap), mean ± SE			Average Yield kg/ha/yr.
		1st year	2nd year	Average	
1	$N_0P_0K_0$	50.86 ± 4.97	63.15 ± 3.36	56.98 ± 2.74	2133.33
2	$N_0P_0K_1$	55.19 ± 4.49	73.86 ± 6.16	64.53 ± 5.32	2416.00
3	$N_0P_0K_2$	51.71 ± 2.89	63.42 ± 4.12	57.57 ± 3.48	2155.42
4	$N_0P_0K_3$	53.21 ± 5.42	69.75 ± 4.77	60.48 ± 4.86	2264.37
5	$N_0P_1K_0$	48.47 ± 3.44	69.75 ± 4.00	59.11 ± 2.35	2213.08
6	$N_0P_1K_1$	55.06 ± 6.28	70.91 ± 1.63	62.99 ± 3.40	2358.35
7	$N_0P_1K_2$	70.07 ± 6.03	88.64 ± 4.55	79.36 ± 5.20	2971.05
8	$N_0P_1K_3$	60.38 ± 2.04	61.33 ± 4.86	60.86 ± 3.34	2278.60
9	$N_0P_2K_0$	57.12 ± 3.87	62.36 ± 3.51	59.74 ± 3.46	2236.67
10	$N_0P_2K_1$	65.65 ± 3.32	74.40 ± 2.18	70.03 ± 2.25	2621.92
11	$N_0P_2K_2$	46.82 ± 2.78	59.77 ± 0.88	56.63 ± 3.51	2120.23
12	$N_0P_2K_3$	61.84 ± 1.57	80.92 ± 5.55	71.38 ± 3.40	2672.47
13	$N_0P_3K_0$	61.44 ± 3.55	75.60 ± 5.28	68.52 ± 4.21	2565.39
14	$N_0P_3K_1$	56.93 ± 1.27	78.60 ± 7.06	65.97 ± 4.66	2469.98
15	$N_0P_3K_2$	61.99 ± 3.23	78.60 ± 8.72	70.30 ± 5.91	2632.03
16	$N_0P_3K_3$	61.35 ± 1.75	73.42 ± 3.21	67.58 ± 2.11	2530.20
17	$N_1P_0K_0$	64.52 ± 5.30	76.62 ± 4.68	70.57 ± 4.87	2642.14
18	$N_1P_0K_1$	49.49 ± 2.26	73.05 ± 5.19	60.77 ± 3.53	2275.23
19	$N_1P_0K_2$	56.71 ± 3.91	85.29 ± 2.96	71.01 ± 3.43	2658.61
20	$N_1P_0K_3$	54.67 ± 5.61	68.37 ± 5.39	61.52 ± 5.28	2303.31
21	$N_1P_1K_0$	64.19 ± 6.98	78.76 ± 6.79	71.50 ± 6.89	2676.96
22	$N_1P_1K_1$	65.39 ± 3.69	76.66 ± 6.38	71.03 ± 4.49	2659.36
23	$N_1P_1K_2$	49.41 ± 2.60	60.79 ± 3.19	55.10 ± 0.82	2062.94
24	$N_1P_1K_3$	56.97 ± 2.93	74.31 ± 4.34	65.64 ± 2.94	2457.56
25	$N_1P_2K_0$	60.14 ± 3.31	88.27 ± 5.12	74.21 ± 4.19	2778.42
26	$N_1P_2K_1$	68.52 ± 4.36	82.20 ± 6.43	75.36 ± 5.31	2821.48
27	$N_1P_2K_2$	66.89 ± 5.33	87.37 ± 6.60	77.26 ± 5.68	2892.61
28	$N_1P_2K_3$	72.06 ± 6.03	79.64 ± 7.09	75.85 ± 6.42	2839.82
29	$N_1P_3K_0$	52.07 ± 5.60	63.69 ± 2.28	57.88 ± 3.92	2167.03
30	$N_1P_3K_1$	57.50 ± 5.22	62.82 ± 7.00	60.17 ± 6.09	2252.77

Contd. table 4. 4. 1.

SL No.	Treatment	Yield (cc/tree/tap), mean ± SE			Average Yield kg/ha/yr.
		1st year	2nd year	Average	
31	$N_1P_3K_2$	58.97 ± 2.55	78.39 ± 7.44	68.68 ± 4.24	2571.38
32	$N_1P_3K_3$	57.89 ± 4.60	72.20 ± 5.36	65.05 ± 4.83	2435.47
33	$N_2P_0K_0$	54.16 ± 5.06	65.78 ± 5.73	59.97 ± 5.08	2245.28
34	$N_2P_0K_1$	58.53 ± 2.06	81.19 ± 5.66	69.99 ± 2.44	2620.43
35	$N_2P_0K_2$	67.97 ± 4.78	80.88 ± 6.42	74.29 ± 4.95	2781.42
36	$N_2P_0K_3$	56.48 ± 6.79	72.18 ± 1.48	64.16 ± 4.12	2402.15
37	$N_2P_1K_0$	46.41 ± 1.16	57.87 ± 3.42	52.14 ± 1.77	1952.12
38	$N_2P_1K_1$	65.17 ± 7.05	76.92 ± 6.82	71.04 ± 6.93	2659.74
39	$N_2P_1K_2$	44.59 ± 2.16	60.27 ± 3.95	52.43 ± 1.57	1962.98
40	$N_2P_1K_3$	55.95 ± 4.33	61.15 ± 8.45	58.55 ± 5.47	2192.11
41	$N_2P_2K_0$	48.18 ± 4.16	66.92 ± 9.56	64.22 ± 0.49	2404.40
42	$N_2P_2K_1$	43.83 ± 2.44	58.36 ± 4.76	51.09 ± 3.55	1912.81
43	$N_2P_2K_2$	50.61 ± 4.34	72.20 ± 5.65	61.41 ± 4.35	2299.19
44	$N_2P_2K_3$	49.79 ± 2.71	62.67 ± 6.73	56.90 ± 3.73	2130.35
45	$N_2P_3K_0$	59.61 ± 4.53	65.28 ± 4.79	62.45 ± 4.61	2338.13
46	$N_2P_3K_1$	66.59 ± 5.95	79.53 ± 11.34	73.06 ± 8.64	2735.37
47	$N_2P_3K_2$	63.33 ± 7.41	76.51 ± 9.24	70.92 ± 8.34	2655.26
48	$N_2P_3K_3$	56.61 ± 5.61	67.48 ± 8.77	62.05 ± 6.75	2323.15
49	$N_3P_0K_0$	45.93 ± 3.63	70.91 ± 4.25	58.42 ± 1.49	2187.25
50	$N_3P_0K_1$	45.78 ± 2.12	57.43 ± 10.52	51.62 ± 5.34	1932.65
51	$N_3P_0K_2$	51.25 ± 4.00	67.03 ± 4.14	59.09 ± 3.12	2212.33
52	$N_3P_0K_3$	58.65 ± 4.17	67.03 ± 6.17	62.82 ± 4.89	2351.98
53	$N_3P_1K_0$	53.26 ± 1.90	58.56 ± 3.45	55.91 ± 2.68	2093.27
54	$N_3P_1K_1$	48.74 ± 4.12	71.70 ± 8.61	60.22 ± 5.44	2254.64
55	$N_3P_1K_2$	58.35 ± 8.69	74.35 ± 5.60	65.52 ± 5.62	2453.07
56	$N_3P_1K_3$	69.39 ± 9.42	97.27 ± 6.53	83.33 ± 6.88	3119.88
57	$N_3P_2K_0$	44.57 ± 7.12	50.47 ± 5.57	47.53 ± 5.72	1779.52
58	$N_3P_2K_1$	69.99 ± 4.56	101.07 ± 5.24	85.60 ± 2.80	3204.86
59	$N_3P_2K_2$	77.24 ± 4.68	96.16 ± 9.64	86.70 ± 6.91	3246.05
60	$N_3P_2K_3$	49.56 ± 3.60	68.57 ± 9.83	59.06 ± 6.39	2211.21
61	$N_3P_3K_0$	56.51 ± 6.22	66.64 ± 3.99	61.58 ± 4.87	2305.56
62	$N_3P_3K_1$	44.41 ± 2.96	53.37 ± 3.37	48.89 ± 2.61	1830.44
63	$N_3P_3K_2$	46.74 ± 4.32	61.29 ± 5.44	54.02 ± 0.63	2022.51
64	$N_3P_3K_3$	55.47 ± 6.96	73.96 ± 8.09	64.72 ± 7.39	2423.12
Mean		56.91 ± 0.75	71.78 ± 0.97	64.47± 0.79	

Table 4. 4. 2. Latex production under different fertilizer treatments in site – 2.

SL No.	Treatment	Yield (cc/tree/tap), mean ± SE			Average Yield kg/ha/yr.
		1st year	2nd year	Average	
1	$N_0P_0K_0$	52.02 ± 1.88	61.00 ± 1.83	56.51 + 1.80	2115.73
2	$N_0P_0K_1$	53.26 ± 1.41	65.99 ± 0.17	59.62 ± 0.76	2232.17
3	$N_0P_0K_2$	60.08 ± 0.84	72.60 ± 2.91	66.34 ± 1.55	2483.77
4	$N_0P_0K_3$	67.45 ± 0.37	76.17 ± 1.99	71.81 ± 1.18	2688.57
5	$N_0P_1K_0$	56.50 ± 1.70	65.92 ± 1.66	61.04 ± 1.70	2285.34
6	$N_0P_1K_1$	54.08 ± 0.62	62.50 ± 2.77	58.30 ± 1.52	2182.75
7	$N_0P_1K_2$	60.80 ± 1.38	70.99 ± 1.74	65.90 ± 1.56	2467.30
8	$N_0P_1K_3$	56.76 ± 1.97	69.10 ± 2.29	62.93 ± 2.13	2356.10
9	$N_0P_2K_0$	60.38 ± 1.94	72.38 ± 2.65	66.38 ± 2.06	2485.27
10	$N_0P_2K_1$	53.09 ± 2.20	63.35 ± 1.85	58.22 ± 1.79	2179.76
11	$N_0P_2K_2$	55.24 ± 0.97	70.49 ± 2.05	62.87 ± 1.36	2353.85
12	$N_0P_2K_3$	54.17 ± 1.74	68.44 + 1.67	61.30 ± 1.69	2295.07
13	$N_0P_3K_0$	55.63 ± 1.93	71.35 ± 1.11	63.48 ± 1.45	2376.69
14	$N_0P_3K_1$	60.27 ± 0.91	73.04 ± 1.51	66.66 ± 1.21	2495.75
15	$N_0P_3K_2$	52.70 ± 1.17	71.35 ± 2.09	61.03 ± 0.74	2284.96
16	$N_0P_3K_3$	57.97 ± 1.45	67.14 ± 1.50	62.56 ± 0.66	2342.25
17	$N_1P_0K_0$	56.60 ± 1.49	62.57 ± 1.24	60.26 ± 1.54	2256.13
18	$N_1P_0K_1$	56.55 ± 1.82	66.20 ± 1.76	61.38 ± 1.71	2298.07
19	$N_1P_0K_2$	62.24 ± 1.22	74.73 ± 0.26	68.49 ± 0.71	2564.27
20	$N_1P_0K_3$	59.67 ± 2.30	74.65 ± 2.44	67.16 ± 2.18	2514.47
21	$N_1P_1K_0$	63.99 ± 1.15	69.93 ± 0.33	66.96 ± 0.71	2506.98
22	$N_1P_1K_1$	57.51 ± 0.65	69.73 ± 2.22	63.62 ± 1.22	2381.93
23	$N_1P_1K_2$	60.94 ± 2.52	66.99 ± 3.21	63.96 ± 2.86	2394.66
24	$N_1P_1K_3$	64.54 ± 1.88	73.84 ± 1.74	69.19 + 1.81	2590.47
25	$N_1P_2K_0$	55.80 ± 1.28	67.41 ± 1.22	61.61 ± 0.52	2306.68
26	$N_1P_2K_1$	56.96 ± 2.42	71.24 ± 4.63	64.10 ± 3.26	2399.90
27	$N_1P_2K_2$	49.24 ± 0.70	64.12 ± 2.18	56.68 ± 1.42	2122.10
28	$N_1P_2K_3$	49.70 ± 1.01	66.64 ± 2.29	58.17 ± 1.60	2177.89
29	$N_1P_3K_0$	53.68 ± 1.91	62.45 ± 2.72	58.07 ± 2.02	2174.14
30	$N_1P_3K_1$	71.88 ± 1.97	82.38 ± 2.89	77.13 ± 2.40	2887.75

Contd. table 4. 4. 2.

SL No.	Treatment	Yield (cc/tree/tap), mean ± SE			Average Yield kg/ha/yr.
		1^{st} year	2^{nd} year	Average	
31	$N_1P_3K_2$	58.17 ± 2.03	68.22 ± 1.62	64.86 ± 2.57	2428.36
32	$N_1P_3K_3$	59.61 ± 1.44	72.91 ± 4.11	66.26 ± 2.58	2480.77
33	$N_2P_0K_0$	46.68 ± 1.62	59.53 ± 0.44	52.95 ± 0.81	1982.45
34	$N_2P_0K_1$	66.06 ± 1.46	81.24 ± 2.11	73.65 ± 1.61	2757.46
35	$N_2P_0K_2$	56.36 ± 1.61	68.64 ± 1.31	62.50 ± 1.10	2340.00
36	$N_2P_0K_3$	60.92 ± 1.72	73.96 ± 1.07	67.42 ± 0.57	2524.21
37	$N_2P_1K_0$	63.01 ± 2.08	68.68 ± 2.77	65.85 ± 1.94	2465.42
38	$N_2P_1K_1$	66.60 ± 3.16	79.71 ± 4.10	73.12 ± 3.48	2737.61
39	$N_2P_1K_2$	74.71 ± 2.70	85.13 ± 2.47	79.76 ± 2.41	2986.21
40	$N_2P_1K_3$	43.81 ± 2.98	59.91 ± 1.71	51.87 ± 1.37	1942.01
41	$N_2P_2K_0$	63.97 ± 1.72	78.75 ± 3.26	71.36 ± 2.47	2671.72
42	$N_2P_2K_1$	51.06 ± 1.48	56.97 ± 1.70	54.02 ± 1.48	2022.51
43	$N_2P_2K_2$	63.88 ± 2.17	73.88 ± 1.96	68.88 ± 1.83	2578.87
44	$N_2P_2K_3$	57.56 ± 1.82	67.95 ± 1.27	62.76 ± 1.35	2349.73
45	$N_2P_3K_0$	65.12 ± 0.97	78.69 ± 4.31	71.91 ± 2.62	2692.31
46	$N_2P_3K_1$	69.43 ± 2.37	79.45 ± 3.05	74.45 ± 1.83	2787.41
47	$N_2P_3K_2$	53.49 ± 1.60	69.03 ± 3.04	61.26 ± 2.19	2293.57
48	$N_2P_3K_3$	61.59 ± 2.14	74.65 ± 2.12	68.28 ± 2.20	2556.40
49	$N_3P_0K_0$	60.68 ± 1.97	69.33 ± 1.58	65.01 ± 1.76	2433.97
50	$N_3P_0K_1$	63.53 ± 2.04	80.13 ± 2.72	71.83 ± 2.37	2689.32
51	$N_3P_0K_2$	58.57 ± 1.53	69.50 ± 2.14	60.05 ± 1.79	2248.27
52	$N_3P_0K_3$	68.18 ± 1.69	75.11 ± 0.60	71.65 ± 1.02	2682.58
53	$N_3P_1K_0$	62.52 ± 2.72	75.63 ± 1.81	69.08 ± 2.10	2586.36
54	$N_3P_1K_1$	61.83 ± 2.15	73.99 ± 2.79	66.25 ± 3.33	2480.40
55	$N_3P_1K_2$	69.20 ± 1.47	79.78 ± 2.43	74.49 ± 1.95	2788.91
56	$N_3P_1K_3$	62.30 ± 0.76	74.48 ± 0.98	68.39 ± 0.46	2560.52
57	$N_3P_2K_0$	60.39 ± 1.79	66.38 ± 1.05	63.39 ± 1.40	2373.32
58	$N_3P_2K_1$	63.95 ± 0.71	75.58 ± 0.85	69.76 ± 0.17	2611.81
59	$N_3P_2K_2$	56.72 ± 1.95	67.28 ± 2.09	62.00 ± 1.88	2321.28
60	$N_3P_2K_3$	58.15 ± 1.01	65.68 ± 1.98	62.79 ± 2.34	2350.86
61	$N_3P_3K_0$	70.34 ± 1.99	83.16 ± 2.42	76.75 ± 1.95	2873.52
62	$N_3P_3K_1$	56.01 ± 1.90	65.42 ± 2.46	61.39 ± 1.24	2298.44
63	$N_3P_3K_2$	69.55 ± 1.66	86.20 ± 3.63	77.88 ± 2.63	2915.83
64	$N_3P_3K_3$	65.72 ± 1.81	74.61 ± 0.49	70.18 ± 0.86	2627.54
Mean		59.68 ± 0.48	71.16 ± 0.52	65.43 ± 0.48	

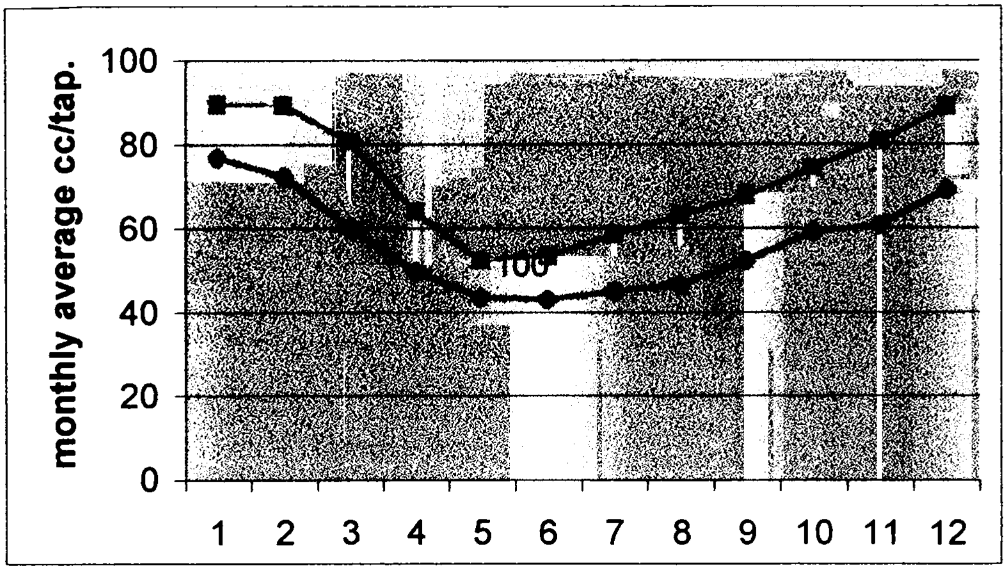

Figure 4.4.1. Month wise latex yields variation for the study period in site-1.

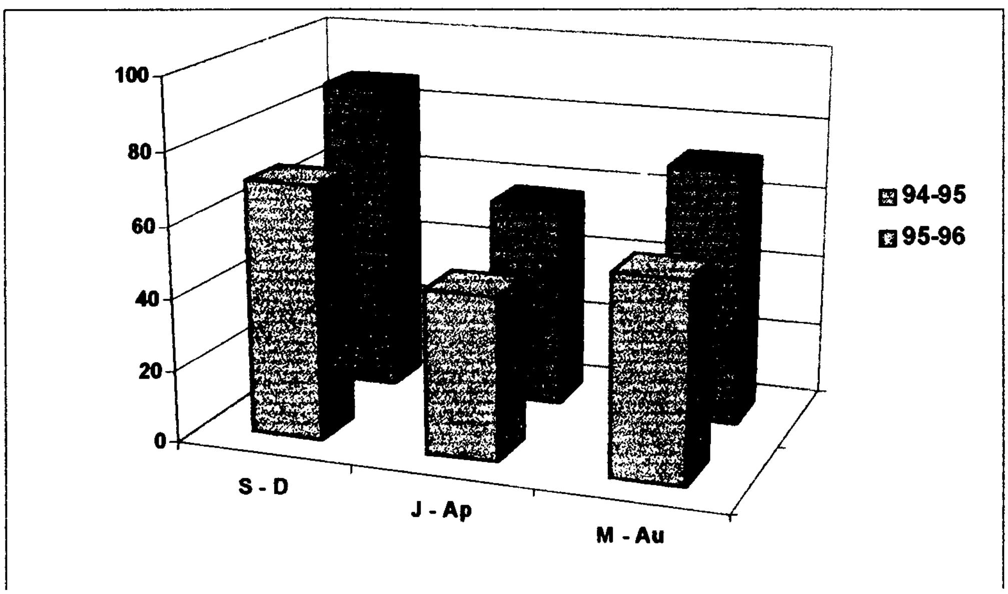

Figure4.4.2. Periodic variation of latex yields in site-1 for the study period.

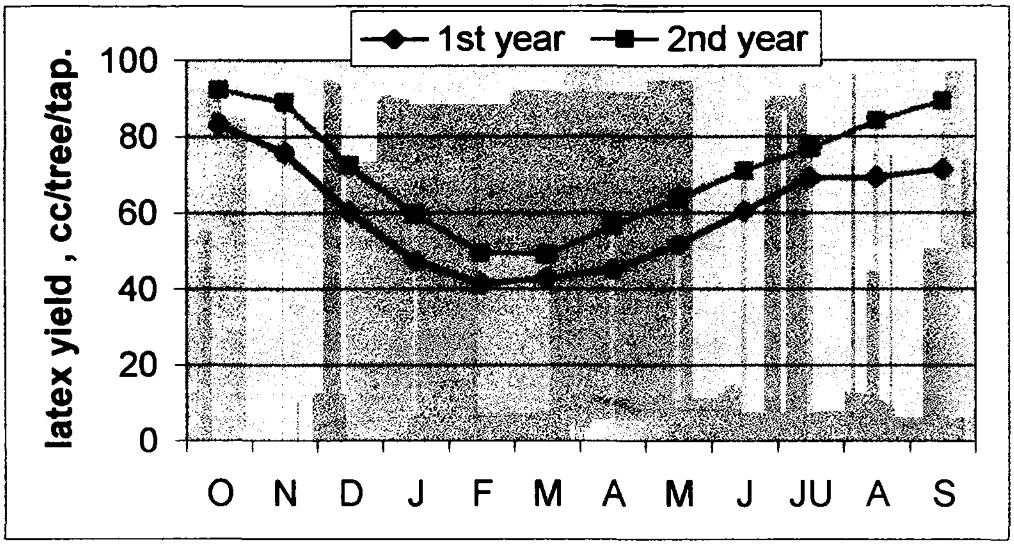

Figure4.4.3. Month wise latex yields variation for the study period in site-2.

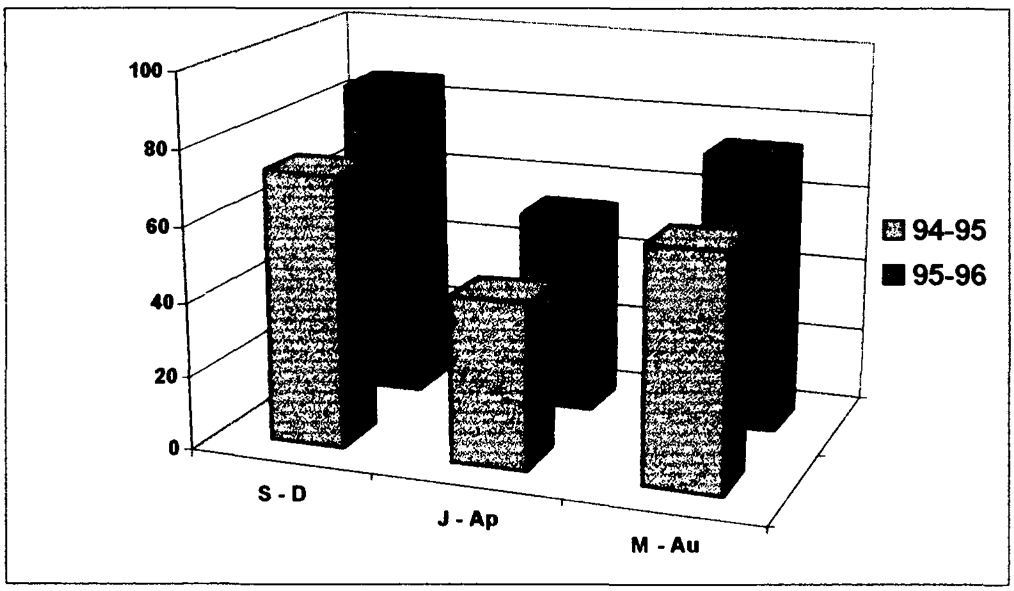

Figure 4.4.4. Perodic variation of latex yiels in site-2 for the study period.

4. 4. 3. Site-3

Latex yield data for site-3 are presented in Table 4. 4. 3. Mean average yield of latex for two years was 67.14 cc/tree/tap. Average latex yield in the first and second year was 58.78 and 75.77 cc/tree/tap respectively. The lowest yield of latex during first year was found in treatment $N_2 P_1 K_3$ (47.80 cc/tree/tap) and the highest in treatment $N_2P_2K_0$ (74.37 cc/tree/tap). In the second year the treatments $N_0P_0K_0$ and $N_1P_3K_2$ showed respectively the lowest (64.39 cc/tree/tap) and the highest yield (89.46 cc/tree/tap). The average values of two years varied from 58.78 ($N_0P_0K_0$) to 78.41 cc/tree/tap ($N_2P_2K_0$). Yield of latex when expressed on hectare basis ranged from 2200.72 to 2935.67 kg/yr.

For comparison of latex yield in Bangladesh with some other countries, latex yield data of some earlier workers are given here. Cardoso and Igue (1990) recorded 92 cc latex/tree/tap in 1983 and 66 cc in 1986, with an average of 83.7 cc in AVROS-1279 clone. In Fx-25 there was 93 cc/tree/tap in 1987 and 60 cc in 1983. The maximum values of latex production per tree basis in the presently studied sites are fairly comparable to these. Estilai (1991) observed a range of latex yield about 1850 to 6400 kg/ha/yr. Martin and Arruda (1992) concluded that the profitability would be achieved with yield of latex of about 3600 kg/ha/yr. Better profit may be obtained if latex yields remain about 4500 kg/ha/yr. Serier (1989) observed an average latex yield of about 1900 kg/ha/yr in Thailand. Abdulla and Lai (1981) reported the average latex yield of 46 estates, which was about 4500 kg/ha/yr. Ng (1981) studied the affect of tree density (211-1067 tree/ha) for clone RRIM -600 and RRIM-701. He found that average of 8 years of latex yield was about 6960 kg/ha/yr for RRIM-600 at 850 tree/ha but the yield in RRIM-701 was lower due to less tree density (680 tree/ha). But the corresponding yield at the conventional planting density of 400 tree/ha showed 6000 to 6060 kg/ha/yr. Lee and Tan (1979) studied the variations in daily latex production and dry matter content (DRC) for clones of GT-1, PB5/51, RRIM-6000 and RRIM-701. Those were tapped in two systems for a year and the highest latex yield but the lowest DRC were obtained in RRIM-600. PB5/51 had the lowest yield and the highest DRC under both the systems. On an average, yield in both the systems were more closely associated with daily latex volume than with DRC. It was possible during the last 40 years for the Indian Rubber Board (Patel, 1997) to boost up rubber yield from 320 to 1422 kg/ha/yr through improved management, fertilizer application and introducing high yielding varieties.

Table 4. 4. 3. Latex production under different fertilizer treatments in site- 3.

SL No.	Treatment	Yield (cc/tree/tap), mean ± SE			Average Yield kg/ha/yr.
		1st year	2nd year	Average	
1	$N_0P_0K_0$	53.16 ± 2.96	64.39 ± 0.29	58.78 ± 1.72	2200.72
2	$N_0P_0K_1$	53.20 ± 1.41	68.04 ± 3.42	60.62 ± 1.50	2269.61
3	$N_0P_0K_2$	55.02 ± 2.83	73.68 ± 2.31	64.35 ± 2.38	2409.26
4	$N_0P_0K_3$	56.18 ± 0.78	65.82 ± 0.49	61.00 ± 0.38	2283.84
5	$N_0P_1K_0$	60.69 ± 3.19	79.56 ± 1.96	69.29 ± 0.33	2594.22
6	$N_0P_1K_1$	63.89 ± 1.93	73.82 ± 3.34	68.87 ± 2.20	2578.49
7	$N_0P_1K_2$	57.93 ± 3.01	78.44 ± 2.38	68.19 ± 0.32	2553.03
8	$N_0P_1K_3$	62.98 ± 2.59	75.08 ± 1.90	67.37 ± 3.80	2522.33
9	$N_0P_2K_0$	62.73 ± 5.26	73.49 ± 2.19	67.77 ± 3.46	2537.31
10	$N_0P_2K_1$	48.66 ± 4.49	85.46 ± 2.62	66.76 ± 2.82	2499.49
11	$N_0P_2K_2$	62.67 ± 3.43	75.67 ± 1.75	69.17 ± 2.45	2589.73
12	$N_0P_2K_3$	63.43 ± 3.07	74.43 ± 4.52	68.93 ± 3.62	2580.74
13	$N_0P_3K_0$	55.16 ± 1.57	70.64 ± 2.23	62.90 ± 0.70	2354.98
14	$N_0P_3K_1$	55.76 ± 3.14	77.96 ± 3.80	66.87 ± 2.79	2503.61
15	$N_0P_3K_2$	55.49 ± 2.04	83.19 ± 0.21	69.34 ± 0.95	2596.09
16	$N_0P_3K_3$	56.85 ± 3.25	72.50 ± 2.01	64.49 ± 2.02	2414.51
17	$N_1P_0K_0$	65.54 ± 3.94	81.34 ± 3.16	73.78 ± 3.75	2762.32
18	$N_1P_0K_1$	53.76 ± 1.59	73.79 ± 2.43	63.77 ± 1.99	2387.55
19	$N_1P_0K_2$	57.54 ± 1.74	75.53 ± 3.91	66.54 ± 2.42	2491.26
20	$N_1P_0K_3$	57.97 ± 3.17	82.46 ± 2.64	70.22 ± 2.84	2629.04
21	$N_1P_1K_0$	65.86 ± 0.74	78.76 ± 5.28	72.32 ± 2.96	2707.66
22	$N_1P_1K_1$	65.29 ± 1.71	80.62 ± 2.46	72.79 ± 1.78	2725.26
23	$N_1P_1K_2$	55.41 ± 0.65	69.33 ± 2.83	62.37 ± 1.73	2335.13
24	$N_1P_1K_3$	59.69 ± 2.29	70.15 ± 1.20	64.92 ± 2.19	2430.61
25	$N_1P_2K_0$	48.92 ± 2.55	73.28 ± 1.61	60.97 ± 1.56	2282.72
26	$N_1P_2K_1$	63.25 ± 2.40	87.96 ± 3.07	75.61 ± 2.02	2830.84
27	$N_1P_2K_2$	59.45 ± 0.66	68.50 ± 2.65	63.97 ± 1.24	2395.04
28	$N_1P_2K_3$	59.05 ± 1.60	72.43 ± 2.17	65.75 ± 1.33	2461.68
29	$N_1P_3K_0$	51.01 ± 2.86	68.95 ± 1.24	59.98 ± 1.80	2245.65
30	$N_1P_3K_1$	57.47 ± 1.16	73.40 ± 2.41	65.10 ± 1.53	2437.34

Contd. table 4. 4. 3.

SL No.	Treatment	Yield (cc/tree/tap), mean ± SE			Average Yield kg/ha/yr.
		1st year	2nd year	Average	
31	$N_1P_3K_2$	57.17 ± 2.94	89.46 ± 2.03	69.89 ± 4.90	2616.68
32	$N_1P_3K_3$	55.62 ± 1.36	71.04 ± 0.73	63.00 ± 1.06	2358.72
33	$N_2P_0K_0$	56.41 ± 2.49	78.06 ± 5.56	67.24 ± 3.66	2517.47
34	$N_2P_0K_1$	59.54 ± 1.19	69.83 ± 0.75	64.69 ± 0.94	2421.99
35	$N_2P_0K_2$	61.33 ± 3.04	73.61 ± 4.15	66.89 ± 2.16	2504.36
36	$N_2P_0K_3$	69.54 ± 3.71	83.61 ± 3.03	75.91 ± 2.86	2842.07
37	$N_2P_1K_0$	62.93 ± 4.63	76.34 ± 5.49	69.64 ± 5.21	2607.32
38	$N_2P_1K_1$	60.55 ± 1.60	81.04 ± 2.84	70.46 ± 1.83	2638.02
39	$N_2P_1K_2$	60.83 ± 1.30	75.09 ± 3.38	67.96 ± 2.33	2544.42
40	$N_2P_1K_3$	47.80 ± 0.96	70.25 ± 3.08	59.03 ± 2.02	2210.08
41	$N_2P_2K_0$	74.37 ± 3.23	82.44 ± 2.24	78.41 ± 2.68	2935.67
42	$N_2P_2K_1$	63.29 ± 0.56	72.80 ± 1.89	68.05 ± 1.02	2547.79
43	$N_2P_2K_2$	61.50 ± 2.04	87.54 ± 2.46	74.52 ± 1.29	2790.03
44	$N_2P_2K_3$	67.82 ± 2.02	82.86 ± 3.39	75.34 ± 2.52	2820.73
45	$N_2P_3K_0$	61.54 ± 5.84	83.08 ± 4.12	72.31 ± 4.48	2707.29
46	$N_2P_3K_1$	54.28 ± 3.31	73.56 ± 3.87	63.92 ± 3.55	2393.16
47	$N_2P_3K_2$	52.63 ± 2.53	67.17 ± 2.15	59.91 ± 2.16	2243.03
48	$N_2P_3K_3$	50.71 ± 0.81	73.60 ± 3.65	62.16 ± 2.01	2327.27
49	$N_3P_0K_0$	62.09 ± 2.79	83.01 ± 2.66	72.55 ± 1.17	2716.27
50	$N_3P_0K_1$	64.99 ± 2.92	77.94 ± 3.95	71.38 ± 3.51	2672.47
51	$N_3P_0K_2$	64.75 ± 3.34	78.29 ± 2.32	71.69 ± 2.40	2684.07
52	$N_3P_0K_3$	60.51 ± 3.06	76.44 ± 1.55	68.48 ± 2.28	2563.89
53	$N_3P_1K_0$	52.06 ± 2.45	70.16 ± 3.37	61.11 ± 2.89	2287.96
54	$N_3P_1K_1$	63.82 ± 1.71	84.11 ± 2.66	73.97 ± 0.78	2769.44
55	$N_3P_1K_2$	58.10 ± 3.36	76.10 ± 1.38	67.10 ± 1.32	2512.22
56	$N_3P_1K_3$	58.00 ± 3.30	78.95 ± 2.41	68.48 ± 2.27	2563.89
57	$N_3P_2K_0$	52.38 ± 2.04	64.86 ± 1.07	58.95 ± 1.54	2207.09
58	$N_3P_2K_1$	62.66 ± 2.47	83.00 ± 2.44	72.93 ± 2.09	2730.50
59	$N_3P_2K_2$	54.06 ± 0.61	69.79 ± 2.59	61.60 ± 1.30	2306.30
60	$N_3P_2K_3$	63.71 ± 1.63	77.18 ± 2.43	70.45 ± 1.24	2637.65
61	$N_3P_3K_0$	58.87 ± 4.72	70.79 ± 3.48	64.83 ± 4.09	2427.24
62	$N_3P_3K_1$	57.52 ± 1.49	78.18 ± 5.16	67.85 ± 1.80	2540.30
63	$N_3P_3K_2$	51.52 ± 2.61	68.98 ± 3.09	60.11 ± 2.45	2250.52
64	$N_3P_3K_3$	55.07 ± 2.90	72.11 ± 1.50	63.51 ± 2.08	2377.81
Average		58.78 ± 0.47	75.77 ± 0.52	67.14 ± 0.43	2513.72

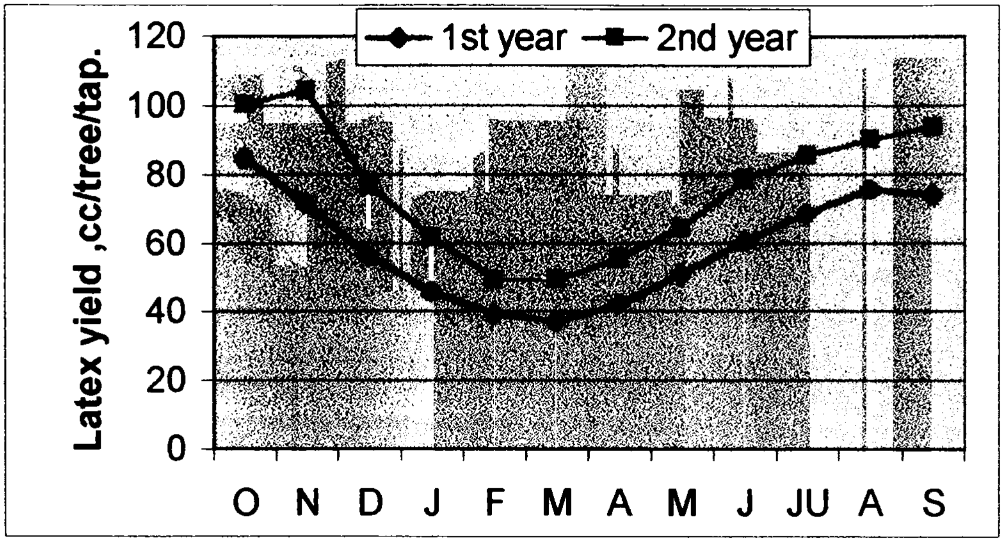

Figure4.4.5. Monthwise latex yields variation for the study period in site-3.

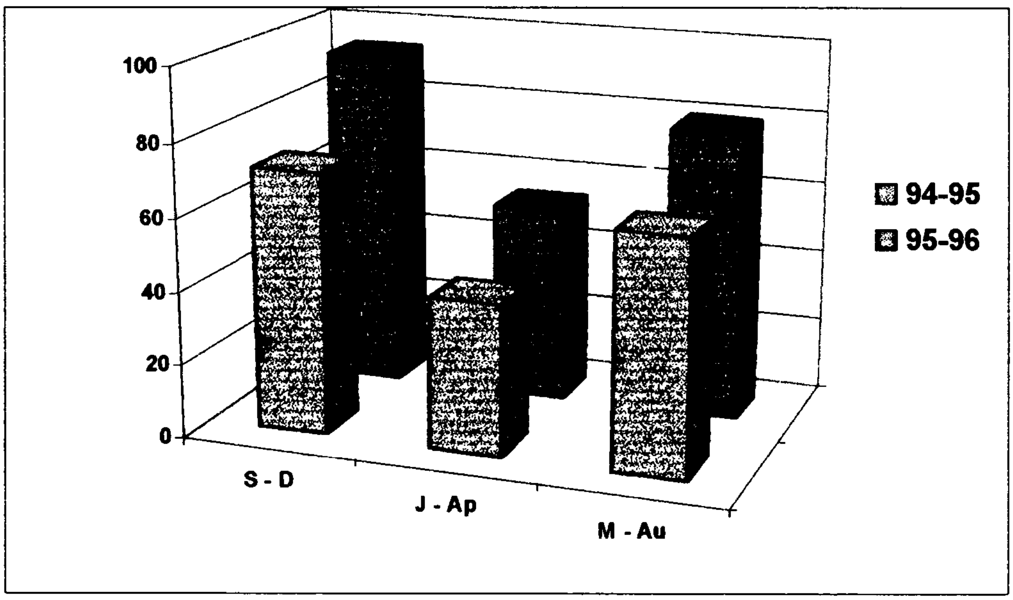

Figure 4.4.6. Periodic variation of latex yields in site-3 for the study period

Haris and Dereinda (1990) recorded latex production of 1577 kg/ha/yr. Gowda *et al.* (1990) surveyed the plantations under different companies and private owner in Karnataka and found that RRII-105, GT-1, RRIM-6000 and TJIR-1 on the average contributed about 2400 kg/ha/yr to 7800 kg/ha/yr latex yield.

Thus in the present study, latex production ranges of 1780 to 3246 kg/ha/yr in site-1, 1942 to 2986 kg/ha/yr in site-2 and 2201 to 2936 kg/ha/yr in site-3 even after fertilizer application appear to be low to medium. The clone PBIG (in site-2) is considered to be high yielding but present yield values were not so. Chan (1975) observed that clone RRIM-600 yielded on an average RSS (Ribbed Smoked Sheet) of 1492 kg/ha/yr in Typic Paleudult soil. The present soil was Humic Paleudult giving the estimated highest RSS of 909 kg/ha/yr and average of 689 kg/ha/yr (28% of latex). Chan (1975) hypothesized that rubber production below 1000 kg/ha/yr may be stated as average to low and more than 1350 kg /ha/yr as higher yield. Pushparajah *et al.* (1975) concluded that Typic Paleudults produced the highest yield of 720 kg/ha/yr. The soil is not unsuitable for rubber; probably past management is responsible for this low yield. The tree density in Dantmara Rubber Estate appears to be low resulting in a low production per unit area.

In Bangladesh R.S.S and scrap (cup lump and tree lace) ratio for six estates was determined from July to May (Caskie 1983). They found around 9.0% scrap of total R.S.S. but mud lump was found about 50-67% of total scrap. In Dantmara Rubber Estate latex and R.S.S., R.S.S. and scrap contents were evaluated for three years based on factory records. It was found that R.S.S. contributed to produce about 8-9.20% scrap while latex yielded about 32% of R.S.S.

4. 4. 4. Variation in latex yield due to fertilizers and their interactions

Detailed analyses of variance for the effects of added fertilizers and their interactions are presented in Appendix LXV. As revealed by F-values presented in Table 4. 4. 4 added nitrogen fertilizers in the first, second and average of both the years, carried out significant variation in latex production in site-1 individually. Potassium fertilizers individually brought out significant variation in latex yield only in the second year and in average values. NxP and NxPxK interactions had highly significant effects on latex yield in this site. Interactions of PxK and NxK had no significant effect on latex yield. In site-2 however, all the fertilizers individually and combinedly (NxP, PxK, NxK and NxPxK) affected latex yield positively in the second year.

Table 4. 4. 4. F values for yield of latex due to fertilizers and their interactions.

Source of variation	Degree of freedom	Site-1			Site-2			Site-3		
		1st yr	2nd yr	Av	1st yr	2nd yr	Av	1st yr	2nd yr	Av
N	3	3.84*	3.30*	3.76*	35.13***	17.28***	29.03***	2.67*	2.15 ns	3.26*
P	3	1.81 ns	1.48 ns	2.48 ns	22.46**	14.90***	20.78***	11.40***	2.02 ns	7.75***
K	3	2.55 ns	4.08**	3.58*	1.39 ns	4.72**	3.31*	0.89 ns	3.18*	1.90 ns
NxP	9	5.59***	4.81***	5.64***	4.68***	2.11**	2.73**	5.82***	6.26***	6.64***
PxK	9	1.19 ns	0.83 ns	1.08 ns	18.60***	9.40***	14.67***	2.44**	4.06***	3.06***
NxK	9	1.15 ns	1.70 ns	1.57 ns	6.79***	4.72***	5.65***	2.82**	4.62***	4.03**
NxPxK	27	3.61***	3.70***	4.22***	12.39***	9.57***	12.53***	3.65***	4.49***	3.29***

In the first year, individual effect of K was not significant although its interaction with N and P (PxK, NxK) were significant. In site-3 too, the individual effect of K was not significant. N and P individually and all the two way (NxP, PxK, NxK) or three way (NxPxK) interactions had significant effect on latex yield of this site. The same trend was repeated in case of the average values. In contrast, individual effects of N and P in the second year were not significant. The levels of significance were, however, shown in Table 4. 4. 4.

4. 4. 5. Variation in latex yield due to fertilizer levels

Effects of each level N, P and K on latex yield in all sites were compared with other levels for the study period (Table 4. 4. 5 to 4. 4. 7).

4. 4. 5. 1. Between levels of nitrogen

Pair-wise comparisons for different levels of N on latex yield are given in Table 4. 4. 5. On an average, N_2 and N_3 produced significantly less latex than N_1 after one and two years in site-1. This was also the trend if average values of the two years are considered. Higher production by N_1 over N_0 was also observed but this increase was not statistically significant. In site-2, all other levels of N increased latex yield over N_0 after one year and as average of both years. N_2 and N_3 gave significantly higher latex yield than N_0 after two years. N_2 and N_3 also produced significantly higher latex than N_1 while N_3 gave significantly higher latex yield than N_2 and N_1 in both the years and in average of two years. Therefore, yield of latex generally increased with increasing level of N in this site. In site-3, generally nitrogen fertilizers produced higher latex over N_0 but the difference between N_0 and N_2 was only significant in both the years and as average of two years. However, N_2 significantly increased latex yield over N_1 in the first year.

4. 4. 5. 2. Between levels of phosphorus

Pair-wise comparisons for the effects of different levels of K are shown in Table 4. 4. 6. In site-1, the only significant difference was found in effects between P_0 and P_2. Increased latex yield was obtained at P_2 over P_0 after one year and as average of two years. Differences in pairs of other levels have not been significant.

Table 4. 4. 5. Pair-wise comparisons of the effects of each level of nitrogen on latex with its other levels.

(I) N	(J) N	Mean Difference (I-J)								
		Site-1			Site-2			Site-3		
		1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average
0	1	-2.02	-4.00	-2.94	-1.67*	-0.76	-1.43*	-0.58	-1.61	-1.06
	2	2.20	2.45	1.86	-3.37*	-3.40*	-3.44*	-2.58*	-2.50*	-2.65*
	3	2.95	0.54	1.84	-6.08*	-5.03*	-5.62*	-1.02	-1.19	-1.31
1	2	4.22*	6.45*	4.81*	-1.70*	-2.63*	-2.01*	-2.00*	-0.89	-0.59
	3	4.97*	4.54*	4.79*	-4.41*	-4.27*	-4.19*	-0.44	0.42	-0.25
	0	2.02	4.00	2.94	1.67*	0.76	1.43*	0.58	1.61	1.06
2	1	-4.22*	-6.45*	-4.81*	1.70*	2.63*	2.01*	2.00*	0.89	1.59
	3	0.75	-1.91	-0.02	-2.71*	-1.63*	-2.18*	1.56	1.31	1.34
	0	-2.20	-2.45	-1.86	3.37*	3.40*	3.44*	2.58*	2.50*	2.65*
3	1	-4.97*	-4.54*	-4.79*	4.41*	4.27*	4.19*	0.44	-0.42	0.25
	2	0.75	1.91	0.02	2.71*	1.63*	2.18*	-1.56	-1.31	-1.34
	0	-2.95	-0.54	-1.84	6.08*	5.03*	5.62*	1.02	1.19	1.31

Dependent variable is latex yield. The values were based on estimated marginal means.

*. The mean difference is significant at the 0.05 level.

Table 4. 4. 6. Pair-wise comparisons of the effects of each level of phosphorus on latex with its other levels.

(I) P	(J) P	Mean Differenee (I-J)								
		Site-1			Site-2			Site-3		
		1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average
0	1	-2.60	-0.21	-1.46	-1.89*	-0.94	-1.26	-0.27	-0.81	-0.44
	2	-3.61*	-3.46	-4.32*	2.41*	2.18*	2.27*	-1.03	-1.70	-1.37
	3	-2.65	0.53	-1.13	-2.02*	-3.04*	-2.60*	4.05*	0.62	2.57*
1	2	-1.00	-3.26	-2.86	4.30*	3.11*	3.53*	-0.76	-0.89	-0.96
	3	0.04	0.74	0.34	-0.13	-2.11*	-1.34*	4.32*	1.43	2.98*
	0	2.61	0.21	1.46	1.89*	0.94	1.26	0.27	0.81	0.42
2	1	1.00	3.26	2.86	-4.30*	-3.11*	-3.53*	0.76	0.89	0.96
	3	0.96	4.00	3.20	-4.43*	-5.22*	-4.87*	5.08*	2.32*	3.94*
	0	3.61*	3.46	4.32*	-2.41*	-2.18*	-2.27*	1.03	1.70	1.37
3	1	0.04	-0.74	-0.34	0.13	2.21*	1.34*	-4.32*	-1.43	-2.98*
	2	-0.96	-4.00	-3.20	4.43*	5.22*	4.87*	-5.08*	-2.32*	-3.94*
	0	2.65	-0.53	1.13	2.02*	3.04*	2.60*	-4.05*	-0.62	-2.57*

Dependent variable is latex yield. The values were based on estimated marginal means.

*. The mean difference is significant at the 0.05 level.

In site-2, P_1 and P_3 increased latex yield over P_0 after one year. P_3 also gave significantly higher latex yield compared to that of P_0 after two years and average of first and second year. Significantly less latex was observed generally at P_2 than P_0 and at P_2 than P_1 after both years and in the average values. P_3 gave significantly higher latex yield than P_2 at all occasions. There was no significant difference in effects between P_3 and P_1 in the first year, but in the second year P_3 gave higher yield than P_1. In both the years and in average values, P_3 produced higher latex than P_2. In site-3, P_1 and P_2 slightly increased latex over P_0 but to an insignificant extent, while P_3 significantly reduced latex yield in the first year and on average of two years probably due to interaction with other nutrients. There was no significant difference between P_1 and P_2 at any of the periods but P_1 had higher latex yield values than P_3 in the first year and on average of two years. P_2 also had higher latex yield than P_3.

4. 4. 5. 3. Between levels of potassium

Comparisons in yield of latex between levels of K are presented in Table 4. 4. 7. In site-1, all higher levels of K increased latex yield over K_0 in both the years and their averages. However, effects of K_2 and K_3 were not significantly different from K_1. There was also no significant relation between K_2 and K_3. In site-2, K_1 and K_2 gave significantly higher latex yield than K_0 after two years and average of first and second year. Other pairs were not significantly different in their contribution to the yield of latex. In site-3, K_1 gave significantly higher latex yield than K_0 and K_3 after two years. K_1 also had higher values than K_2 when average of two years were taken. There was no significant difference in other pairs in their effects on latex yield.

Earlier workers on effects of fertilizers on yield latex presented contrasting data. There are reports that fertilizers increase latex yield up to a limit of fertilizer increment and decrease afterwards. An immediate response of latex yield to added fertilizers have seldom been reported. Rather, fertilizers were found be effective after one or two years of application. Results of Pushparajah (1969), Pushparajah, *et al.* (1971), Sivanadyan, *et al.* (1972), Haridas *et al.* (1975) may be cited in this context. They concluded that normally an increase in yield begins slowly and start to show up only in the 3rd year or even later.

Table 4. 4. 7. Pair-wise comparisons of the effects of each level of potassium on latex with its other levels.

(I) K	(J) K	Mean Difference (I-J)								
		Site-1			Site-2			Site-3		
		1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average
0	1	-3.08	-5.72*	-3.85*	-0.92	-2.11*	-1.43*	-0.26	-2.71*	-1.47
	2	-3.76*	-6.90*	-5.13*	-0.91	-2.86*	-1.90*	1.14	-0.78	0.41
	3	-3.93*	-4.35*	-3.70*	-0.05	-1.38	-0.76	-0.08	0.07	0.07
1	2	-0.68	-1.18	-1.28	0.01	-0.75	-0.47	1.41	1.92	1.88*
	3	-0.84	1.37	0.15	0.87	0.73	0.67	0.11	2.64*	1.54
	0	3.08	5.72*	3.85*	0.92	2.11*	1.43*	0.26	2.71*	1.47
2	1	0.68	1.18	1.28	-0.01	0.75	0.47	-1.41	-1.92	-1.88*
	3	-0.16	2.55	1.43	0.86	1.48	1.14	-1.22	0.72	-0.34
	0	3.76*	6.90*	5.13*	0.91	2.86*	1.90*	-1.14	0.78	-0.41
3	1	0.84	-1.37	-0.15	-0.87	-0.73	-0.67	-0.11	-2.64*	-1.54
	2	0.16	-2.55	-1.43	-0.86	-1.48	-1.14	1.22	-0.72	0.34
	0	3.93*	4.35*	3.70*	0.05	1.38	0.76	0.08	0.07	-0.07

Dependent variable is latex yield. The values were based on estimated marginal means.
*. The mean difference is significant at the 0.05 level.

Peng (1988) also reported that the effect of fertilizer application could vary from one year to less than three years or even more depending on the nutritional status of tree. He further concluded that in case of gross deficiency, fertilizer application to mature plant results in yield increase in one year or less. But in most cases, there was no increase in yield after two years of fertilizer application. Adiwiganda (1979) conducted a 4- year study on the effect of N, P and K fertilizers on mature rubber in a yellowish brown podzolic soil. He observed that latex yield was not affected significantly by fertilizer application. Moreover, application of 126g and 252g urea/tree reduced yield by 3% and 6% respectively at the fourth year compared to no N fertilizer. Many workers observed yield response to P application where the soil P was low to medium (Owen 1953, RRIM 1965, Guha and Pushparajah 1966 and Chan 1971) but no significant difference where soil P was high. Angkapradipta, *et al.* (1986) showed a marked response of mature latex yielding trees to added N and K but not to P in trials on a low fertility latosol, while optimum urea and potassium chloride rates were 533.34 g and 180.36 g/tree respectively. Reis *et al.* (1986) found almost similar results on yield response by P_2O_5 treatment. Reis and Rosand (1988) studied the effect of N, P_2O_5 and K_2O fertilizer application respectively at 60, 90 and 60 kg/ha/yr during pre- and post-tapping periods. They observed that phosphorus produced the greatest increase in trunk girth during both the periods and rubber productivity was increased by 97%.

In Nigeria, a 3-year field experiment showed that N and K fertilizers increased yield of rubber but P fertilizers had no positive effect. Application of 500 g ammonium sulfate, 500 g muriate of potash and 250 g magnesium sulfate/tree/yr increased the annual yield respectively by 11%, 3% and 9% (Onuwaje, 1983). Punnooose *et al.* (1975) observed significant yield reduction at higher levels of N as compared to lower doses during the two years' experiments. In K rich soil, such as those abundant in mica and those better in K availability, the added K did not show any significant increment in latex yield, rather might have created a nutritional imbalance resulting in depression in yield (Chan 1975). John (1967) noticed that K application in medium K rich soil showed an increase in yield. It was also mentioned, higher Mg content in soil depressed K uptake. For better yield, good Mg-K balance is essential. He suggested that requirement of a particular nutrient was related also to the status of other nutrients in soil. Samaraweera (1984) suggested that potassium addition also enhanced calcium mobility. It was also noticed that K had a positive effect on transportation of sucrose, the component of carbohydrate, which is the precursor of latex. Yogaratnam and Weerasuriya (1984) observed that urea at the rate of 210 g/tree/yr and K_2O at the rate of 190 g/tree/yr increased yield; K being effective not in all sites. Deying (1983) found K limitation in some parts of China. He obtained a beneficial effect from applied K fertilizers and further suggested that maintenance of N-K balance was important.

Peng (1988) observed that application of N fertilizers gave definite response in yield. On hectare basis, he reported extra yield of 296 kg/ha (dry matter in latex) due to added fertilizers in comparison to control (N_0). It was also observed that in P treated plantation yield increased 215 kg/ha/yr as compared to control (P_0). He further observed that K in most cases increased yield but K could further increase yield in presence of N. He reported contribution of N, P, and NxK on dry matter yield respectively by 75, 108 and 109 kg/ha/yr. He noted that combined application of N, P and K are effective than single fertilizer application. Kim *et al.* (1996) found that there were significant treatment but no interaction effects on mean dry rubber yield per ha/year over 4 years of tapping.

In the present experiments, all the fertilizers affected latex yield individually or in combination at one or all periods, but the response differed with the sites. Not always the higher level of a fertilizer produced better than its previous level. The highest latex values after 2 years were observed in treatments $N_3P_2K_2$, $N_2P_1K_2$ and $N_2P_2K_0$ in site-1, 2 and 3 respectively. From pair-wise comparisons for different levels of N, P and K above, the probable combinations of fertilizers for significantly higher response in yield of latex should be $N_1P_2K_2$ in site-1, $N_3P_3K_2$ in site-2 and $N_2P_1K_1$ or $N_2P_2K_1$ in site-3. The treatment $N_1P_2K_2$ in site-1 yielded 2893 kg/ha/yr, while $N_3P_3K_2$ in site-2 gave 2916 kg/ha/yr. In site-3 $N_2P_1K_1$ and $N_2P_2K_1$ had latex yield values of 2638 and 2548 kg/ha/yr respectively. The maximum latex yield values in site-1, 2 and 3 were 3246, 2986 and 2936 kg/ha/yr respectively.

The differences in response of the sites might be due to clonal and edaphic variations. The clones in these sites were TJIR-1, PBIG and RRIM-600 but the soils were almost of similar fertility. Physical properties may however differ to create differences in root environment. Soil textural classes of site-1, 2 and 3 were sandy loam to loam, loam to clay loam and loam respectively. However, it has further been examined whether the highest yield produced the highest profit or not.

4. 5. Profitability Analysis

Tables 4. 5. 1, 4. 5. 2 and 4. 5. 3 present the costs involved in fertilizers and fertilizer application and economic returns as well as profit/loss due to fertilizer treatment over the control respectively in site-1, site-2 and site-3. Total variable cost (TVC) was the amount spent for the specific fertilizer doses and labour costs involved in land preparation and fertilizer application. Total return was estimated by the prices of ribbed smoked sheet, scrap and mudlump. Return above variable cost (RAVC) was the difference between total return and total variable cost. There was no cost involved in fertilizer and application in the control plots. So, the total return and RAVC was the same in $N_0P_0K_0$ treatment. Added return due to fertilizers was estimated by subtracting the RAVC of control from that of other treatments. Dividing added returns by the TVC gave the marginal benefit cost ratio (MBCR). The derivation was described in detail in the Chapter- Materials and Methods.

A negative value of added return indicated loss due fertilizer application. Loss was observed in eighteen treatments in site-1 (including 3 N_0, 6 K_0 and 4 P_0 treatments), in four treatments in site-2 ($N_1P_2K_2$, $N_2P_0K_0$, $N_2P_1K_3$, and $N_2P_2K_1$) and in five treatments in site-3 ($N_1P_3K_0$, $N_2P_1K_3$, $N_2P_3K_2$, $N_3P_2K_0$ and $N_3P_3K_2$). Loss ranged from Tk. 264.00 to 10,000.00 in site-1, from Tk. 543.00 to 4430.00 in site- 2 and from Tk. 661.00 to 1504.00 in site-3. However, positive added return i.e. profit due to fertilizers ranged from Tk. 22.00 ($N_1P_3K_1$) to 18540.00 ($N_3P_1K_3$) in site-1, from Tk. 537.00 ($N_1P_2K_3$) to 18055.00 ($N_2P_1K_2$) in site-2 and from Tk. 311.00 ($N_1P_2K_0$) to 14260.00 ($N_2P_2K_0$) in site-3. Average profits (added returns) due to fertilizers in site-1, 2 and 3 were Tk. 3762.00, 6682.00 and 5286.00 respectively against average fertilizer application costs of Tk. 1416.00 only.

The profit expressed relative to inputs in fertilizers was the MBCR which ranged from -18.8 to 13.39 in site-1, -3.00 to 12.70 in site-2 and 0.98 to 11.09 in site-3. A MBCR value of 1.00 indicated that the added return was equal to the fertilizer input. A negative MBCR likewise indicated the loss in proportion to the fertilizer input. MBCR values less than 1.00 also indicated a profit but to a less proportion. An MBCR value of 5.00 meant five times extra profit over the cost of fertilizer application. In the present experiment higher than 1.00 MBCR were observed in 37 treatments in site-1, 58 treatments in site-2 and 51 treatments in site-3. MBCR values higher than 5.00 were obtained in 22 treatments in site-1, 30 treatments in site-2 and 19 treatments in site-3. Theresa (1999) suggested that MBCR should be above 2.00 when a change in crop production technology is adopted. However, this should not apply in the present experiments because all variable costs, for example processing costs, were not included in the present estimation. The principal aim of the present investigation was to compare the effects of different fertilizer combinations over no fertilizer use.

However, the MBCR values obtained with different treatments in the sites were statistically tested (Appendices LXXIV - LXXVI). F-values presented in Table 4.5.4 showed that all the fertilizers and their combinations highly and significantly influenced the MBCR in all the sites. Different levels of N, P and K brought about these variations. Pair-wise comparisons for each level of a fertilizer over its other levels were also studied. The values of mean difference and their level of significance are given in Table 4. 5. 5. In all sites N_1 level gave significantly higher MBCR than the control. N_2 and N_3 levels also contributed higher to the MBCR over control in site-2 and site-3, but these levels reduced MBCR over control in site-1. However, each level of nitrogen differed significantly with other in its contribution to the MBCR. It appears that N_1, N_3 and N_2 levels were better in site-1, site-2 and in site-3 respectively.

Comparisons of different levels of P for their attribute to the MBCR also appear in Table 4. 5. 5. In site-2 only, P_1 gave slightly but significantly higher relative profit than the control. Other levels of P in this site, and all levels of P in other sites reduced the MBCR significantly over the control. However, P_2 was better than P_1 and P_3 in site-1. On the other hand, P_1 and P_3 were better than P_1 in site-2. P_1 was better than P_2, and P_2 was better than P_3 in site-3. In the overall consideration P_0 was more profitable in site-1 and site-3, while P_1 was more profitable in site-2 as far as MBCR was concerned.

Pair-wise comparison for different levels of K presented also in Table 4. 5. 5 showed that all levels K in site-1, K_1 and K_2 in site-2 increased the MBCR significantly. On the basis of the significant mean difference, K_1 should be more preferable in site-1 and site-2. This level of K gave significantly higher MBCR than the other levels. In site-3, none of the levels of K increased MBCR over control.

On the basis of the above discussion and in the context of profitability analyses, the estimated logical fertilizer combinations should be $N_1P_0K_1$ for site-1, $N_3P_1K_1$ for site-2, and $N_2P_0K_0$ for site-3. However, the highest MBCR values were found in treatments $N_3P_2K_2$ (13.39), $N_2P_1K_2$ (12.70) and $N_1P_0K_0$ (11.89) in site-1, site-2 and site-3 respectively. The observed MBCR for the estimated combination for site-1 was close to the highest value, but those for site-2 (MBCR=5.17) and site-3 (MBCR=3.06) were considerably less.

Table 4. 5. 6 shows the mean values of MBCR for different levels of N, P and K fertilizers and the significant difference in MBCR between any two levels of a particular fertilizer was indicated by different letters based on DMRT. On these significant variations, fertilizer combinations for better levels of extra profit could be shown in Table 4. 5. 7. Among these dozes, $N_1P_2K_1$ for site-1, $N_2P_1K_1$, $N_2P_1K_2$ and $N_3P_1K_2$ for site-2, and $N_1P_1K_1$ and $N_2P_1K_1$ for site-3 should be preferred. Any combination containing 0 level of a fertilizer should be avoided because long-term effects could deplete the native available reserve of the nutrient.

Yogaratnam and Weerasuriya (1984) concluded from long term fertilizer trials on mature rubber tree that application of N, P, K, Ca and Mg fertilizers may not be profitable in view of fertilizer costs and rubber prices. In the present experiments, most of the treatments brought appreciable profit. Yew *et al.* (1980) observed that manuring rubber trees increased profit by 33 percent.

Table 4. 5. 1. Profitability analyses of fertilizer treatments in site-1.

SL No.	Treatment	TVC (Tk.)*	Financial return (Tk.)				RAVC** (Tk.)	Added returns (Tk.)	MBCR***
			RSS	Scrap	Mud-lump	Gross Return			
1	$N_0P_0K_0$	0.00	43569.45	2822.04	275.97	46667.46	46667.46	00.00	0.00
2	$N_0P_0K_1$	943.20	49342.52	3195.97	312.53	52851.02	51907.82	5240.36	5.56
3	$N_0P_0K_2$	1058.40	44020.59	1962.62	191.92	46175.13	45116.73	-1550.73	-1.47
4	$N_0P_0K_3$	1173.60	46245.71	2061.82	201.62	48509.15	47335.55	668.09	0.60
5	$N_0P_1K_0$	1006.56	45198.14	2015.12	197.06	47410.32	46403.76	-263.70	-0.26
6	$N_0P_1K_1$	1121.76	48164.96	2147.39	209.99	50522.35	49400.59	2733.13	2.43
7	$N_0P_1K_2$	1236.96	60682.20	2705.46	264.57	63652.22	62415.26	15747.80	12.73
8	$N_0P_1K_3$	1323.36	46536.27	2074.77	202.89	48813.94	47490.58	823.12	0.62
9	$N_0P_2K_0$	1185.12	45679.87	2036.59	199.16	47915.62	46730.50	63.04	0.05
10	$N_0P_2K_1$	1300.32	53548.06	2387.39	233.46	56168.92	54868.60	8201.14	6.30
11	$N_0P_2K_2$	1415.52	43301.82	1930.57	188.79	45421.19	44005.67	-2661.79	-18.8
12	$N_0P_2K_3$	1530.72	54580.33	2433.41	237.96	57251.71	55720.99	9053.53	5.91
13	$N_0P_3K_0$	1363.68	52393.45	2335.91	228.43	54957.79	53594.11	6926.65	5.08
14	$N_0P_3K_1$	1478.88	50443.61	2248.98	219.93	52912.51	51433.63	4766.17	3.42
15	$N_0P_3K_2$	1594.08	53754.52	2396.59	234.36	56385.47	54791.39	8123.93	5.09
16	$N_0P_3K_3$	1709.28	51674.68	2303.86	225.30	54203.85	52494.57	5827.11	3.40
17	$N_1P_0K_0$	920.16	53960.97	2405.80	235.26	56602.03	55681.87	9014.41	9.80
18	$N_1P_0K_1$	1035.36	46467.45	2071.71	202.59	48741.75	47706.39	1038.93	10.03
19	$N_1P_0K_2$	1150.56	54297.41	2420.80	236.73	56954.94	55804.38	9136.92	7.94
20	$N_1P_0K_3$	1265.76	47040.94	2097.28	205.09	49343.31	48077.55	1410.08	1.11
21	$N_1P_1K_0$	1098.72	54672.09	3541.17	346.29	58559.55	57460.83	10793.37	9.82
22	$N_1P_1K_1$	1213.92	54312.71	2421.48	236.79	56970.99	55757.07	9089.61	7.49
23	$N_1P_1K_2$	1329.12	42131.92	1878.41	183.69	44194.02	42864.90	-3802.56	-2.86
24	$N_1P_1K_3$	1473.12	50191.27	2237.73	218.82	52647.83	51174.71	4507.25	3.06
25	$N_1P_2K_0$	1277.28	56744.28	2529.89	247.39	59521.57	58244.29	11576.83	9.06
26	$N_1P_2K_1$	1392.48	57623.62	2569.10	251.23	60443.95	59051.47	12384.01	8.90
27	$N_1P_2K_2$	1507.68	59076.44	2633.87	257.57	61967.88	60460.20	13792.74	9.14
28	$N_1P_2K_3$	1622.88	57998.29	2585.80	252.87	60836.96	59214.08	12546.62	7.73
29	$N_1P_3K_0$	1455.84	44257.63	1973.19	192.96	46423.77	44967.93	-1699.53	-1.17
30	$N_1P_3K_1$	1571.04	46008.67	2051.25	200.59	48260.51	46689.47	22.01	0.01

* Total variable cost, ** Return above variable cost, and *** Marginal benefit cost ratio.

Table 4.5.1. contd.

SL No.	Treatment	TVC (Tk.)*	Financial return (Tk.)				RAVC** (Tk.)	Added returns (Tk.)	MBCR***
			RSS	Scrap	Mud-lump	Gross Return			
31	$N_1P_3K_2$	1686.24	52515.79	2341.37	228.96	55086.12	53399.88	6732.42	3.99
32	$N_1P_3K_3$	1801.44	49740.13	2217.62	216.86	52174.61	50373.17	3705.71	2.06
33	$N_2P_0K_0$	1012.32	45855.74	2044.44	199.93	48100.10	47087.78	420.32	0.41
34	$N_2P_0K_1$	1127.52	53517.48	2386.03	233.33	56136.83	55009.31	8341.85	7.40
35	$N_2P_0K_2$	1242.72	56805.45	2532.62	247.67	59585.73	58343.01	11675.55	9.40
36	$N_2P_0K_3$	1357.92	49059.60	2187.28	213.89	51460.77	50102.85	3435.39	2.53
37	$N_2P_1K_0$	1190.88	39868.57	1777.50	173.82	41819.90	40629.02	-6038.44	-5.07
38	$N_2P_1K_1$	1306.08	54320.35	2421.82	236.83	56979.01	55672.93	9005.47	6.90
39	$N_2P_1K_2$	1421.28	40090.32	1787.39	174.79	42052.50	40631.22	-6036.24	-4.25
40	$N_2P_1K_3$	1536.48	44769.94	2899.80	283.57	47953.31	46416.83	-250.63	-0.16
41	$N_2P_2K_0$	1369.44	49105.48	2189.32	214.09	51508.89	50139.45	3471.99	2.53
42	$N_2P_2K_1$	1484.64	39065.69	1741.71	170.32	40977.72	39493.08	-7174.38	-4.83
43	$N_2P_2K_2$	1599.84	46956.83	2093.53	204.73	49255.08	47655.24	987.78	0.61
44	$N_2P_2K_3$	1715.04	43508.28	1939.78	189.69	45637.75	43922.71	-2744.75	-1.60
45	$N_2P_3K_0$	1548.00	47752.06	2128.98	208.19	50089.23	48541.23	1873.77	1.21
46	$N_2P_3K_1$	1663.20	55864.94	2490.69	243.56	58599.17	56935.99	10268.53	6.17
47	$N_2P_3K_2$	1778.40	54228.60	2417.73	236.43	56882.76	55104.36	8436.90	4.74
48	$N_2P_3K_3$	1893.60	47446.20	2115.34	206.86	49768.40	47874.80	1207.34	0.64
49	$N_3P_0K_0$	1104.48	44670.54	1991.59	194.76	46856.89	45752.41	-915.049	-0.83
50	$N_3P_0K_1$	1219.68	39470.96	1759.78	172.09	41402.82	40183.14	-6484.32	-5.31
51	$N_3P_0K_2$	1334.88	45182.85	2014.44	196.99	47394.28	46059.40	-608.06	-0.45
52	$N_3P_0K_3$	1450.08	48034.97	2141.59	209.43	50385.10	48935.92	2268.46	1.56
53	$N_3P_1K_0$	1283.04	42751.28	1906.03	186.39	44843.70	43560.66	-3106.80	-2.42
54	$N_3P_1K_1$	1398.24	46046.90	2052.96	200.76	48300.62	46902.38	234.92	0.17
55	$N_3P_1K_2$	1513.44	50099.52	2233.64	218.43	52551.58	51038.14	4370.68	2.89
56	$N_3P_1K_3$	1628.64	63717.84	2840.80	277.80	66836.44	65207.88	18540.34	11.38
57	$N_3P_2K_0$	1461.60	36343.56	1620.34	158.45	38122.36	36660.77	-10006.70	-6.85
58	$N_3P_2K_1$	1576.80	65453.58	2918.19	285.37	68657.14	67080.34	20412.88	12.95
59	$N_3P_2K_2$	1692.00	66294.69	4293.98	419.91	71008.57	69316.57	22649.11	13.39
60	$N_3P_2K_3$	1807.20	45159.91	2013.41	196.89	47370.22	45563.02	-1104.45	-0.61
61	$N_3P_3K_0$	1640.16	47086.82	2099.32	205.29	49391.43	47751.27	1083.81	0.66
62	$N_3P_3K_1$	1755.36	37383.48	1666.71	162.99	39213.17	37457.81	-9209.65	-5.24
63	$N_3P_3K_2$	1870.56	41306.10	1841.59	180.09	43327.79	41457.23	-5210.23	-2.79
64	$N_3P_3K_3$	1985.76	49487.80	2206.37	215.76	51909.93	49924.17	3256.71	1.64
Mean									

* Total variable cost, ** Return above variable cost, and *** Marginal benefit cost ratio.

Table 4. 5. 2. Profitability analyses of fertilizer treatments in site-2.

SL No.	Treatment	TVC (Tk.)*	Financial return (Tk.)				RAVC** (Tk.)	Added returns (Tk.)	MBCR***
			RSS	Scrap	Mud-lump	Gross Return			
1	$N_0P_0K_0$	0.00	43210.07	1926.48	188.39	45324.94	44496.94	0.00	0.00
2	$N_0P_0K_1$	943.20	45588.11	2032.50	198.76	47819.37	46876.17	2379.24	5.52
3	$N_0P_0K_2$	1058.40	50726.52	2261.59	221.16	53209.28	52150.88	7653.94	7.23
4	$N_0P_0K_3$	1173.60	54909.13	2448.07	239.40	57596.60	56422.99	11926.06	10.16
5	$N_0P_1K_0$	1006.56	46673.91	2080.91	203.49	48958.31	47951.75	3454.81	3.43
6	$N_0P_1K_1$	1121.76	44578.78	1987.50	194.36	46760.64	45638.88	1141.94	1.02
7	$N_0P_1K_2$	1236.96	50390.08	2246.59	219.69	52856.37	51619.41	7122.47	5.76
8	$N_0P_1K_3$	1323.36	48119.09	2145.34	209.79	50474.22	49150.86	4653.92	3.51
9	$N_0P_2K_0$	1185.12	50757.11	2262.96	221.30	53241.36	52056.24	7559.30	6.38
10	$N_0P_2K_1$	1300.32	44517.61	2883.45	281.97	47683.03	46382.71	1885.78	1.45
11	$N_0P_2K_2$	1415.52	48073.21	2143.30	209.59	50426.10	49010.58	4513.64	3.19
12	$N_0P_2K_3$	1530.72	46872.71	2089.78	204.36	49166.85	47636.13	3139.19	2.05
13	$N_0P_3K_0$	1363.68	48539.64	2164.09	211.63	50915.36	49551.68	5054.74	3.70
14	$N_0P_3K_1$	1478.88	50971.21	2272.50	222.23	53465.94	51987.06	7490.12	5.07
15	$N_0P_3K_2$	1594.08	46666.26	2080.57	203.46	48950.29	47356.21	2859.27	1.79
16	$N_0P_3K_3$	1709.28	47836.17	2132.73	208.56	50177.46	48468.18	3971.24	2.32
17	$N_1P_0K_0$	920.16	46077.48	2054.32	200.89	48332.70	47412.54	2915.60	3.17
18	$N_1P_0K_1$	1035.36	46933.89	2092.50	204.63	49231.02	48195.66	3698.72	3.57
19	$N_1P_0K_2$	1150.56	52370.51	2334.89	228.33	54933.73	53783.17	9286.23	8.07
20	$N_1P_0K_3$	1265.76	51353.53	2289.55	223.90	53866.98	52601.22	8104.28	6.40
21	$N_1P_1K_0$	1098.72	51200.60	2282.73	223.23	53706.56	52607.84	8110.90	7.38
22	$N_1P_1K_1$	1213.92	48646.69	2168.87	212.09	51027.65	49813.73	5316.79	4.38
23	$N_1P_1K_2$	1329.12	48906.67	2180.46	213.23	51300.36	49971.25	5474.30	4.12
24	$N_1P_1K_3$	1473.12	52905.76	2358.75	230.66	55495.18	54022.06	9525.12	6.47
25	$N_1P_2K_0$	1277.28	47109.75	2100.34	205.39	49415.49	48138.21	3641.27	2.85
26	$N_1P_2K_1$	1392.48	49013.72	2185.23	213.69	51412.65	50020.16	5523.22	3.97
27	$N_1P_2K_2$	1507.68	43340.06	1932.28	188.96	45461.29	43953.61	-543.33	-0.36
28	$N_1P_2K_3$	1622.88	44479.38	1983.07	193.93	46656.37	45033.49	536.56	0.33
29	$N_1P_3K_0$	1455.84	44402.91	2876.02	281.25	47560.18	46104.34	1607.40	1.10
30	$N_1P_3K_1$	1571.04	58977.04	2629.44	257.13	61863.61	60292.57	15795.63	10.05

* Total variable cost, ** Return above variable cost, and *** Marginal benefit cost ratio.

Table 4.5.2. contd.

SL No.	Treatment	TVC (Tk.)*	Financial return (Tk.)				RAVC** (Tk.)	Added returns (Tk.)	MBCR***
			RSS	Scrap	Mud-lump	Gross Return			
31	$N_1P_3K_2$	1686.24	49594.85	2211.14	216.23	52022.22	50335.98	5839.04	3.46
32	$N_1P_3K_3$	1801.44	50665.35	2258.87	220.90	53145.11	51343.67	6846.74	3.80
33	$N_2P_0K_0$	1012.32	40487.93	1805.12	176.52	42469.57	41457.25	-3039.69	-3.00
34	$N_2P_0K_1$	1127.52	56316.08	2510.80	245.53	59072.41	57944.88	13447.95	11.92
35	$N_2P_0K_2$	1242.72	47790.24	2130.68	208.36	50129.33	48886.61	4389.68	3.53
36	$N_2P_0K_3$	1357.92	51552.34	2298.41	224.76	54075.52	52717.59	8220.66	6.05
37	$N_2P_1K_0$	1190.88	50351.85	2244.89	219.53	52816.27	51625.38	7128.45	5.99
38	$N_2P_1K_1$	1306.08	55910.81	2492.73	243.76	58647.31	57341.23	12844.29	9.83
39	$N_2P_1K_2$	1421.28	60988.05	2719.09	265.90	63973.05	62551.77	18054.83	12.70
40	$N_2P_1K_3$	1536.48	39662.12	1768.30	172.92	41603.34	40066.86	-4430.08	-2.88
41	$N_2P_2K_0$	1369.44	54565.04	2432.73	237.90	57235.67	55866.23	11369.29	8.30
42	$N_2P_2K_1$	1484.64	41306.10	1841.59	180.09	43327.77	41843.15	-2653.79	-1.79
43	$N_2P_2K_2$	1599.84	52668.72	2348.19	229.63	55246.54	53646.70	9149.76	5.72
44	$N_2P_2K_3$	1715.04	47989.10	2139.55	209.23	50337.87	48622.83	4125.89	2.41
45	$N_2P_3K_0$	1548.00	54985.59	2451.48	239.73	57676.81	56128.81	11631.87	7.51
46	$N_2P_3K_1$	1663.20	56927.79	2538.07	248.20	59714.06	58050.86	13553.92	8.15
47	$N_2P_3K_2$	1778.40	46842.13	2088.41	204.23	49134.77	47356.37	2859.43	1.61
48	$N_2P_3K_3$	1893.60	52209.93	3381.69	330.70	55922.32	54028.72	9531.78	5.03
49	$N_3P_0K_0$	1104.48	49709.55	2216.25	216.73	52142.53	51038.05	6541.11	5.92
50	$N_3P_0K_1$	1219.68	54924.42	2448.75	239.46	57612.64	56392.96	11896.02	9.75
51	$N_3P_0K_2$	1334.88	45916.91	2047.16	200.19	48164.26	46829.38	2332.44	1.75
52	$N_3P_0K_3$	1450.08	54786.77	2442.62	238.86	57468.27	56018.19	11521.25	7.94
53	$N_3P_1K_0$	1283.04	52821.65	2355.00	230.30	55406.95	54123.91	9626.97	7.50
54	$N_3P_1K_1$	1398.24	50657.71	2258.53	220.86	53137.09	51738.85	7241.92	5.17
55	$N_3P_1K_2$	1513.44	56958.38	2539.44	248.33	59746.15	58232.71	13735.77	9.08
56	$N_3P_1K_3$	1628.64	52294.05	2331.48	227.10	54853.52	53224.88	8727.94	5.36
57	$N_3P_2K_0$	1461.60	48470.82	2161.03	211.33	50843.18	49381.58	4884.64	3.34
58	$N_3P_2K_1$	1576.80	53341.61	2378.19	232.56	55952.36	54375.56	9878.62	6.26
59	$N_3P_2K_2$	1692.00	47407.97	2113.64	206.69	49728.30	48036.30	3539.36	2.09
60	$N_3P_2K_3$	1807.20	48012.04	2140.56	209.33	50361.93	48554.73	4057.80	2.24
61	$N_3P_3K_0$	1640.16	58686.47	2616.48	255.87	61558.82	59918.66	15421.72	9.40
62	$N_3P_3K_1$	1755.36	46941.53	2092.84	204.66	49239.04	47483.77	2986.74	1.70
63	$N_3P_3K_2$	1870.56	59550.52	2655.00	259.63	62465.16	60594.60	16097.66	8.61
64	$N_3P_3K_3$	1985.76	53662.76	2392.50	233.96	56289.23	54303.56	9806.53	4.94
Mean									

* Total variable cost, ** Return above variable cost, and *** Marginal benefit cost ratio.

Table 4.5.3. Profitability analyses of fertilizer treatments in site-3.

SL No.	Treatment	TVC (Tk.)*	Financial return (Tk.)				RAVC** (Tk.)	Added returns (Tk.)	MBCR***
			RSS	Scrap	Mud-lump	Gross Return			
1	$N_0P_0K_0$	0.00	44945.81	2911.19	284.69	48141.69	47313.68	0.00	0.00
2	$N_0P_0K_1$	943.20	46352.76	2066.60	202.10	48621.44	47678.24	364.56	0.39
3	$N_0P_0K_2$	1058.40	49204.88	2193.76	214.53	51613.16	50554.76	3241.08	3.06
4	$N_0P_0K_3$	1173.60	46643.32	2079.55	203.36	48926.23	47752.63	438.95	0.37
5	$N_0P_1K_0$	1006.56	52982.23	2362.16	230.10	55575.38	54568.82	7255.14	7.21
6	$N_0P_1K_1$	1121.76	52661.07	2347.85	229.60	55238.52	54116.75	6803.07	6.06
7	$N_0P_1K_2$	1236.96	52141.12	2324.66	227.33	54693.11	53456.15	6142.47	4.97
8	$N_0P_1K_3$	1323.36	51514.11	2296.71	224.60	54035.41	52712.05	5398.37	4.08
9	$N_0P_2K_0$	1185.12	51819.97	2310.34	225.93	54356.24	53171.12	5857.44	4.94
10	$N_0P_2K_1$	1300.32	51047.67	2275.91	222.56	53546.15	52245.83	4932.15	3.79
11	$N_0P_2K_2$	1415.52	52890.47	2358.07	230.60	55479.14	54063.62	6749.93	4.77
12	$N_0P_2K_3$	1530.72	52706.95	2349.89	229.77	55286.64	53755.92	6442.24	4.21
13	$N_0P_3K_0$	1363.68	48096.15	2144.32	209.69	50450.16	49086.48	1772.80	1.30
14	$N_0P_3K_1$	1478.88	51131.76	2279.66	222.93	53634.38	52155.50	4841.81	3.27
15	$N_0P_3K_2$	1594.08	53020.46	2363.87	231.16	55615.49	54021.41	6707.73	4.21
16	$N_0P_3K_3$	1709.28	49311.93	2198.53	214.99	51725.45	50016.17	2702.49	1.58
17	$N_1P_0K_0$	920.16	56415.48	2515.23	245.96	59176.68	58256.52	10942.83	11.89
18	$N_1P_0K_1$	1035.36	48761.39	2173.98	212.59	51147.96	50112.60	2798.92	2.70
19	$N_1P_0K_2$	1150.56	50879.45	2268.41	221.83	53369.69	52219.13	4905.45	4.26
20	$N_1P_0K_3$	1265.76	53693.34	3477.77	340.09	57511.21	56245.45	8931.77	7.06
21	$N_1P_1K_0$	1098.72	55299.10	2465.46	241.10	58005.66	56906.94	9593.25	8.73
22	$N_1P_1K_1$	1213.92	55658.48	2481.48	242.66	58382.63	57168.71	9855.02	8.12
23	$N_1P_1K_2$	1329.12	47690.88	2126.25	207.93	50025.07	48695.95	1382.26	1.04
24	$N_1P_1K_3$	1473.12	49640.73	2213.19	216.43	52070.34	50597.22	3283.54	2.23
25	$N_1P_2K_0$	1277.28	46620.38	2078.53	203.20	48902.17	47624.88	311.20	0.24
26	$N_1P_2K_1$	1392.48	57814.78	2577.61	252.07	60644.46	59251.98	11938.30	8.57
27	$N_1P_2K_2$	1507.68	48914.32	2180.80	213.26	51308.38	49800.69	2487.01	1.65
28	$N_1P_2K_3$	1622.88	50275.38	2241.48	219.20	52736.06	51113.18	3799.50	2.34
29	$N_1P_3K_0$	1455.84	45863.38	2044.78	199.98	48108.12	46652.28	-661.40	-0.45
30	$N_1P_3K_1$	1571.04	49778.36	2219.32	217.03	52214.71	50643.67	3329.99	2.12

* Total variable cost, ** Return above variable cost, and *** Marginal benefit cost ratio.

Table 4.5.3. contd.

SL No.	Treatment	TVC (Tk.)*	Financial return (Tk.)				RAVC** (Tk.)	Added returns (Tk.)	MBCR***
			RSS	Scrap	Mud-lump	Gross Return			
31	$N_1P_3K_2$	1686.24	53441.01	2382.62	232.10	56056.62	54370.39	7056.70	4.18
32	$N_1P_3K_3$	1801.44	48172.61	2147.73	210.03	50530.37	48728.93	1415.25	0.79
33	$N_2P_0K_0$	1012.32	51414.70	2292.28	224.16	53931.14	52918.82	5605.14	5.54
34	$N_2P_0K_1$	1127.52	49464.86	2205.34	215.66	51885.87	50758.35	3444.66	3.06
35	$N_2P_0K_2$	1242.72	51147.08	2280.34	222.10	53650.42	52407.69	5094.02	4.10
36	$N_2P_0K_3$	1357.92	58044.17	2587.85	253.07	60885.08	59527.16	12213.48	8.99
37	$N_2P_1K_0$	1190.88	53249.85	2374.10	232.16	55856.11	54665.23	7351.55	6.17
38	$N_2P_1K_1$	1306.08	53876.86	2402.05	234.90	56513.81	55207.73	7894.04	6.04
39	$N_2P_1K_2$	1421.28	51965.25	3365.84	329.15	55660.24	54238.96	6925.27	4.87
40	$N_2P_1K_3$	1536.48	45136.97	2012.39	196.79	47346.15	45809.67	-1504.01	-0.98
41	$N_2P_2K_0$	1369.44	59955.78	2673.07	261.40	62890.26	61520.82	14207.13	10.37
42	$N_2P_2K_1$	1484.64	52034.07	2319.89	226.86	54580.82	53096.18	5782.50	3.89
43	$N_2P_2K_2$	1599.84	56981.32	2540.46	248.43	59770.21	58170.37	10856.68	6.79
44	$N_2P_2K_3$	1715.04	57608.33	2568.41	251.16	60427.90	58712.86	11399.18	6.65
45	$N_2P_3K_0$	1548.0	55291.45	2465.12	241.06	57997.63	56449.63	9135.95	5.90
46	$N_2P_3K_1$	1663.20	48876.08	2179.09	213.09	51268.27	49605.07	2291.39	1.38
47	$N_2P_3K_2$	1778.40	45809.86	2042.39	199.73	48051.97	46273.57	-1040.11	-0.58
48	$N_2P_3K_3$	1893.60	47530.31	2119.09	207.23	49856.63	47963.03	649.35	0.34
49	$N_3P_0K_0$	1104.48	55474.97	2473.21	241.86	58190.13	57085.65	9771.97	8.85
50	$N_3P_0K_1$	1219.68	54580.33	2433.41	237.96	57251.71	56032.03	8718.35	7.15
51	$N_3P_0K_2$	1334.88	54817.37	2443.98	238.10	57500.35	56165.47	8851.79	6.63
52	$N_3P_0K_3$	1450.08	52362.86	2334.55	228.30	54925.71	53475.63	6161.95	4.25
53	$N_3P_1K_0$	1283.04	46727.43	2083.30	203.73	49014.46	47731.42	417.73	0.33
54	$N_3P_1K_1$	1398.24	56560.76	2521.71	246.60	59329.07	57930.83	10617.15	7.59
55	$N_3P_1K_2$	1513.44	51307.65	2287.50	223.70	53818.85	52305.41	4991.73	3.30
56	$N_3P_1K_3$	1628.64	52362.86	2334.55	228.30	54925.71	53297.07	5983.39	3.67
57	$N_3P_2K_0$	1461.60	45075.80	2009.66	196.53	47281.99	45820.38	-1493.30	1.02
58	$N_3P_2K_1$	1576.80	55765.53	3611.99	353.22	59730.74	58153.94	10840.26	6.87
59	$N_3P_2K_2$	1692.00	47102.11	2100.00	205.36	49407.47	47715.47	401.79	0.24
60	$N_3P_2K_3$	1807.20	53869.21	2401.71	234.86	56505.79	54698.58	7384.90	4.08
61	$N_3P_3K_0$	1640.16	49571.91	2210.12	216.13	51998.16	50357.99	3044.31	1.86
62	$N_3P_3K_1$	1755.36	51881.14	2313.07	226.20	54420.41	52665.05	5351.36	3.05
63	$N_3P_3K_2$	1870.56	45962.79	2049.21	200.39	48212.39	46341.83	-971.85	-0.52
64	$N_3P_3K_3$	1985.76	48562.58	2165.12	211.73	50939.42	48953.66	1639.98	0.83
Mean									

*Total variable cost, ** Return above variable cost, and *** Marginal benefit cost ratio.

Table 4. 5. 4. F-values for MBCR due to fertilizers and their interactions.

Source of variation	Degree of freedom	Site-1	Site-2	Site-3
N	3	15913.19***	3078.06***	1213.58***
P	3	1271.14***	6809.34***	9851.57***
K	3	4703.87***	1346.64***	3190.47***
NxP	9	13060.87***	1100.40***	4313.97***
PxK	9	2146.60***	6059.48***	2105.43***
NxK	9	5307.94***	1599.53***	2132.53***
NxPxK	27	11176.65***	4046.13***	2100.14***

***Significant at 0. 1% level.

Table 4. 5. 5. Pair-wise comparisons of the effects of each level of N, P and K with their other levels on MBCR.

(I) N	(J) N	Mean Difference (I-J)		
		Site-1	Site-2	Site-3
0	1	-3.43*	-0.39*	-0.71*
	2	0.26*	-1.16*	-1.15*
	3	0.67*	-1.78*	-0.31*
1	0	3.43*	0.39*	0.71*
	2	3.70*	-0.77*	-0.44*
	3	4.10*	-1.39*	0.39*
2	0	-0.26*	1.16*	1.15*
	1	-3.70*	0.77*	0.44*
	3	0.41*	-0.62*	0.83*
3	0	-0.67*	1.78*	0.31*
	1	-4.10*	1.39*	-0.39*
	2	-0.41*	0.62*	-0.83*
(I) P	(J) P			
0	1	0.35*	-0.05*	0.30*
	2	0.27*	2.47*	0.49*
	3	1.23*	0.61*	3.06*
1	0	-0.35*	0.05*	-0.30*
	2	-0.07*	2.52*	0.19*
	3	0.89*	0.66*	2.76*
2	0	-0.27*	-2.47*	-0.49*
	1	0.07*	-2.52*	-0.19*
	3	0.96*	-1.86*	2.57*
3	0	-1.23*	-0.61*	-3.06*
	1	-0.89	-0.66*	-2.76*
	2	-0.97*	1.86*	-2.57*
(I) K	(J) K			
0	1	-2.51*	-0.81*	-0.01
	2	-1.07*	-0.34*	1.31*
	3	-1.08*	0.43*	1.46*
1	0	2.51*	0.82*	0.01
	2	1.44*	0.48*	1.32*
	3	1.43*	1.24*	1.47*
2	0	1.07*	0.34*	-1.31*
	1	-1.44*	-0.48*	-1.32*
	3	-0.01	0.76*	0.16*
3	0	1.08*	-0.43*	-1.46*
	1	-1.43*	-1.24*	-1.47*
	2	0.01	-0.75*	-0.16*

Dependent variable is latex yield. The values were based on estimated marginal means.
*. The mean difference is significant at the 0.05 level.

Table 4. 5. 6. Mean values of MBCR for different levels of N, P and K and DMRT.

Fertilizer levels	Site-1	Site-2	Site-3
Nitrogen			
0	1.93^{b}	3.91^{d}	3.39^{d}
1	5.36^{a}	4.30^{c}	4.09^{b}
2	1.66^{c}	5.07^{b}	4.53^{a}
3	1.26^{d}	5.70^{a}	3.70^{c}
Phosphorus			
0	3.02^{a}	5.50^{b}	4.89^{a}
1	2.67^{c}	5.55^{a}	4.59^{b}
2	2.74^{b}	3.03^{d}	4.40^{c}
3	1.78^{d}	4.89^{c}	1.83^{d}
Potassium			
0	1.39^{c}	4.56^{c}	4.62^{a}
1	3.90^{a}	5.38^{a}	4.63^{a}
2	2.46^{b}	4.90^{b}	3.31^{b}
3	2.47^{b}	4.13^{d}	3.16^{c}

Figures followed by the same letter(s) in a column and for a particular fertilizer did not differ significantly according to DMRT.

Table 4. 5. 7. Estimated profitable fertilizer combinations and observed MBCR.

Site No	Estimated Fertilizer combinations for better MBCR	Observed MBCR	Remarks
1	$N_1P_0K_1$	10.03	Both the treatments may be acceptable in relation to MBCR but this should also be based on effects on soil fertility and tree nutrition.
	$N_1P_2K_1$	8.93	
2	$N_3P_1K_1$	5.17	The following treatments: $N_3P_0K_1$, $N_3P_1K_2$, $N_2P_1K_1$, $N_2P_0K_1$ and $N_2P_1K_2$ are acceptable but this should also be based on effects on soil fertility and tree nutrition.
	$N_3P_0K_1$	9.75	
	$N_3P_0K_2$	1.75	
	$N_3P_1K_2$	9.08	
	$N_2P_1K_1$	9.83	
	$N_2P_0K_1$	11.92	
	$N_2P_0K_2$	3.53	
	$N_2P_1K_2$	12.70	
3	$N_1P_0K_0$	11.89	The following treatments: $N_1P_0K_0$, $N_1P_1K_0$, $N_1P_1K_1$, $N_2P_1K_1$, $N_2P_0K_0$, and $N_2P_1K_0$ are acceptable but this should also be based on effects on soil fertility and tree nutrition.
	$N_1P_0K_1$	2.70	
	$N_1P_1K_0$	8.73	
	$N_1P_1K_1$	8.12	
	$N_2P_0K_1$	3.06	
	$N_2P_1K_1$	6.04	
	$N_2P_0K_0$	5.54	
	$N_2P_1K_0$	6.17	

4. 6. Selection of fertilizer combinations

The choice of a fertilizer dose should depend on native soil fertility, growth characteristics of the crop, nutrient uptake and assimilation, and targeted increase of yield levels, etc. Therefore, further screening of the fertilizer dozes for better latex yield and profit is needed. The following is an attempt in this regard.

Soils of all the three sites under present investigation are similar in slope and physical properties implying little difference in drainage, leaching, aeration and root growth. These soils belong to the same soil series – Ramgarh classified as Humic Paleudults. Soil pH (1:2.5 soil-water ratio) was around 5.0 and organic matter content was almost same in all the sites. Based on values of total N, and available P and K in different sites under present study, the following prediction could initially be proposed: $N_1P_2K_1$ for site-1, $N_1P_1K_1$ for site-2 and $N_2P_1K_2$ for site-3. Because site-1 was comparatively low in CEC, and available P and site-3 was relatively low in CEC, total N and available K. Therefore, there should be a positive response to added P (and probably K due to low CEC) in site-1, and to N and K in site-3.

From foliar nutrient data predicted fertilizer combinations for rubber trees in sites under present investigation could be $N_1P_1K_2$ in site-1, $N_1P_2K_1$ in site-2 and $N_2P_1K_1$ in site-3. There were comparatively less concentrations of foliar K in site-1, P in site-2 and N in site-3. So, on foliar N, P and K concentrations, there should be more demand of K in site-1, more P in site-2 and more N in site-3.

From statistical estimation, the predicted fertilizer combinations for the best yield of latex were $N_1P_2K_2$ for site-1, $N_3P_3K_2$ for site-2 and $N_2P_1K_1$ or $N_2P_2K_1$ in site-3. The observed values of latex yield were 2893 kg/ha in $N_1P_2K_2$ in site-1 (maximum 3246 kg/ha in $N_3P_2K_2$), 2916 kg/ha in $N_3P_3K_2$ in site-2 (maximum 2986 kg/ha in $N_2P_1K_2$), and 2638 kg/ha in $N_2P_1K_1$ and 2548 kg/ha in $N_2P_2K_1$ in site-3 (maximum 2936 kg/ha in $N_2P_2K_0$).

The treatment $N_1P_2K_2$ in site-1 gave a MBCR of 9.14, $N_3P_3K_2$ in site-2 had 8.61, and $N_2P_1K_1$ and $N_2P_2K_1$ for site-3 contributed MBCR of 6.04 and 3.89 respectively. The treatments giving the highest latex yield in site-1 and site-2 also gave the maximum

MBCR (13.39 in site-1 and 12.70 in site-2) In site-3 the highest yield was obtained in $N_2P_2K_0$ but the highest MBCR was found in $N_1P_0K_0$ (11.89). The estimated profitable combinations were also cited in the previous section. It has also been suggested that 0 levels of any fertilizer should be excluded from combinations due to the risk of fertility depletion.

. In considerations of soil nutrient status, foliar nutrient concentrations, yield of latex and profitability of the present experiments, the suitable fertilizer dozes should be within $N_1P_2K_1$, $N_1P_2K_2$ and $N_3P_2K_2$ in site-1 (MBCR= 8.90, 9.14 and 13.39 respectively), $N_2P_1K_1$, $N_2P_1K_2$, $N_3P_1K_2$ and $N_3P_3K_2$ in site-2 (MBCR= 9.83, 12.70, 9.08 and 8.61 respectively) and $N_1P_1K_1$ and $N_2P_1K_1$ in site-3 (MBCR= 8.12 and 6.04 respectively) of Dantmara Rubber Estate.

CHAPTER 5. SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

A factorial experiment with four levels of each of the three fertilizer elements N, P and K was conducted at three sites of Dantmara Rubber Estate of Chittagong to find out the effect fertilizers on latex yield of *Hevea brasiliensis*. In each of the sites, then, there were 64 fertilizer combinations and were replicated thrice. The treatments were arranged in field following randomized complete block design. Thus there were three blocks, each accommodating 64 treatments. In each site there were a total of 192 plots. Fertilizers were added in September 1994 and September 1995. Yield of latex for each plot was measured month-wise from October 1994 to September 1996. Soils, tree status, weed biomass and leaf litterfall were examined in field before fertilizer application. Soil and leaf samples were analyzed in the laboratory before and after fertilizer application. Profitability of the use of fertilizers in mature rubber plantations was estimated. Necessary statistical analyses were also done to substantiate the results. Main findings of the study are summarized below.

Tree status, weed biomass and leaf litterfall

Percentages of affected branch, partly damaged crown, partly deformed bark and normal trees were 12, 27, 9 and 52 respectively in site-1. In site-2 values for the corresponding parameters were 20, 32, 3 and 45, and in site-3 they were 9, 23, 3 and 65. Canopy closeness was 90% in site-1, 80% in site-2 and 90% in site-3. GBH varied from 74.80 to 93.47 cm with an average of 83.22 cm in site-1. In site-2, the average gbh was 63.48 cm and the range was 55.43 to 70.43 cm. In site-3 gbh ranged from 49.60 to 57.47 cm with average of 53.80 cm. The average numbers of tapped trees were: 231 in the first year and 193 in the following year in site-1, 244 and 206 in the first and second year respectively in site-2, and 277 and 261 in the respective years in site-3. Number of tapped trees in a site also varied with period of the year. The amount of leaf litterfall was estimated in the site-2 and site-3. Site-2 produced 1.54-3.40 t/ha/yr leaf litter with an average of 2.25 t/ha/yr. In site-3 there were 1.93 - 3.63 t/ha/yr leaf litter with an average of 2.90 t/ha/yr. The average nitrogen, phosphorous and potassium concentrations in leaf litter were 1.25, 0.08 and 0.32% respectively in site-2. The corresponding concentrations in site-3 were 1.16, 0.08 and 0.30%. Estimated average N, P and K returns were 28.13, 2.61 and 7.43 kg/ha/yr respectively in site-2 and 33.75, 2.32 and 8.85 kg/ha/yr in site-3.

Weed biomass ranged from 0.20 to 0.52 t/ha with an average of 0.37 t/ha in site-1. The highest weed biomass was recorded in site-2, where average value was 2.59 t/ha and the range was 0.73 to 3.85 t/ha. Minimum and maximum values in site-3 were 1.73 and 2.17 t/ha respectively and the average was 1.51 t/ha.

Soil properties

The soils of the present study belonging to Ramgarh series are classified as Humic Paleudult. Profile characteristics indicated that the soils are well developed and deep enough to favour root extension. Based on land characteristics including soil properties such as depth, texture, moisture regime, pH, colour etc., land capability class was very high.

The soils had almost uniform distribution of clay within the profiles in all the sites and the values varied within 27 to 34 percent. However, there was considerable variation in silt content with depth of soil. In site-1 percentage silt was higher in the surface soil but in other sites higher silt content was found in the subsoil. Bulk density was within 1.2 to 1.34 g/cm^3 and showed irregular variation down the profiles. Cation exchange capacity (CEC) ranged from 5 me/100 g to 10.37 me/100 g. The average CEC was the highest in site-2. The soils were uniformly acid, pH ranging around 5.0 throughout the depths and among the sites. Average organic carbon content in sites 1 and 3 was 0.80%, while there was 0.91% in site-2. Total N was 0.10% in surface soil of site-2 and 0.09% in site-1 and site-3. Total P contents were 221 ppm in site-1, 408 ppm in site-2 and 412 ppm in site-3. Available P contents of the surface horizon were 23, 28 and 38 ppm respectively in sites 1, 2 and 3. Available K content in soils of the sites was almost similar, the average value being around 13.5 me/100 g. The average available Ca contents were 3.38 me/100 g in site-1; 2.71 me/100 g in site-2 and 2.16 me/100 g in site-3. Available Mg content in each site was around 0.29 me /100 g and showed little variation with depth. Available Mn ranged from 4.66 to 20.35 ppm and was higher in soils of site-2.

Thus, soils in site-2 was higher in organic matter and total N and site-1 had higher available Ca and less total as well as available P. Site-3 was relatively low in CEC, total N and available K but high in available Ca

Nutrient status of soil after fertilizer application

After 90 days of fertilizer application, mean total N content at 0-15 cm depth showed the ranges: 0.06 to 0.11% in site-1, 0.04 to 0.13% in site-2 and 0.06 to 0.10% in site-3. Mean available P did not differ significantly among the sites and were within 22 - 23 ppm. Mean available K contents in sites 1, 2 and 3 were 0.24, 0.28 and 0.29 me/100 g respectively and available Ca contents of the corresponding sites were 3.21, 2.17 and 2.94 me/100g. Mean available Mg contents were 0.18, 0.31 and 0.36 me/100g. Mean available P varied only from 13 to 21% among the sites. Available K, Ca and Mg varied widely among the sites under present study.

Soils of the control and some other randomly selected treatments were analyzed for nutrients after 2 years of fertilizer application to observe any change in soil nutrient reserves. In site-1, total N of 0-15 cm depth was the minimum (0.06%) in $N_0P_3K_0$ and maximum (0.10%) in $N_1P_0K_2$ and $N_3P_2K_2$. Most of the values were around 0.08%. Available P ranged from 15 ($N_0P_0K_0$ and $N_2P_0K_1$) to 28 ppm ($N_3P_2K_2$). Available K was minimum (0.08 me/100g) in $N_0P_0K_0$ and maximum (0.24 me/100g) in $N_3P_2K_2$. The lowest and the highest available Ca contents were observed respectively in $N_0P_0K_0$ (1.63 me/100g) and $N_2P_0K_2$ (2.30 me/100g). Available Mg was the least (0.13 me/100g) in the control plots, while the highest was found in $N_3P_1K_3$ (0.37 me/100g). Applied K fertilizer carried out significant variation (5% level) in available K of soil.

In site- 2, total N of 0-15 cm depth was the minimum (0.09%) in the treatments $N_0 P_0 K_0$ and $N_0 P_0 K_3$. The highest concentration (0.16%) was found in $N_2 P_3 K_3$. Most of the values were around 0.13%. Available P ranged from 17 ($N_0P_0K_3$) to 28 ppm ($N_2P_3K_1$) and available K from 0.13 me/100g ($N_0P_0K_0$) to 0.26 me/100g ($N_2P_3K_3$). The minimum and maximum available Ca have been found in $N_0P_0K_3$ (1.32 me/100g) and $N_2P_3K_3$ (2.63 me/100g) respectively. Available Mg was the highest (0.40 me/100g) in $N_2P_1K_2$ while the lowest (0.22 me/100g) in $N_2P_3K_3$. Total N and available P, K and Mg of soil did not vary due to any of the added fertilizers. Applied P fertilizer (TSP) caused significant variation (5% level) in available Ca of soil.

In site-3, total N of 0-15 cm depth ranged from 0.07% ($N_3P_1K_1$ and $N_1P_0K_3$) to 0.10% ($N_1P_2K_1$) available P varied from 16 ($N_0P_0K_0$) to 28 ppm ($N_1P_3K_2$) available K from 0.09 ($N_0P_2K_1$) to 0.21 me/100g ($N_3P_0K_2$ and $N_1P_0K_3$). Available Ca varied between 1.32 ($N_1P_2K_1$) and 2.50 me/100g ($N_1P_3K_2$). Available Mg was found to vary from 0.24 ($N_0P_2K_1$) to 0.38 me/100g soil ($N_2P_1K_1$).

Leaf nutrients

Foliar nutrient concentrations were determined from rubber leaf samples collected immediately before fertilizer application and after fertilizer application during December '94, September '95, December '95 and September '96. Leaf samples at these latter periods were collected and analyzed from only the control and twelve other randomly selected treatments.

Before fertilizer application

Before fertilizer application leaf N concentrations ranged from 2.91 to 3.45 % with an average of 3.04%. Mean leaf N values were 3.12, 3.02 and 2.98% in sites 1, 2 and 3 respectively. Concentration of P was almost similar in three sites, the average of which was 0.24%. Mean concentrations of K were 0.73, 0.94 and 1.04 % in sites 1, 2 and 3 respectively. Calcium concentration in leaf ranged from 0.88 to 1.21% with an average value of 1.02%. Mean concentration was the highest in site-1 (1.18%). The range of foliar Mg was within 0.42 to 0.67% and the average value was 0.53 %. The highest concentration was found in site-3 followed by site-1 and site-2. Mean Mn concentrations were 502, 347 and 338 ppm in sites 1, 2 and 3 respectively.

After fertilizer application

In site-1 leaf N ranged from 2.32 (control) to 3.20% ($N_3P_2K_1$) in December '94, 3.09 ($N_3P_2K_1$) to 3.71% ($N_1P_2K_1$) in September '95, 2.77 ($N_0P_1K_2$) to 3.78 ($N_1P_2K_1$) in December '95 and 2.94 ($N_1P_2K_1$) to 3.40% ($N_0P_3K_0$). Generally leaf N was higher in December '95 than December '94, but the trend was reverse in September. In site-2,

however, mean leaf N values were 2.98%, 3.15%, 2.97% and 3.16% respectively in December '94, September '95, December '95 and September '96. In site-3 mean leaf N contents were 2.97% and 3.21% in December '94 and September '95 respectively. In the second year i.e. in December '95 and September '96 the corresponding mean values were 2.92 and 3.12 %. The coefficients of variation were 5 to 9% in site-2 and 6 to 9% in site-3. So, the mean values did not differ much from the individual values.
The mean values of leaf P were 0.21% to 0.25% at all the periods and at all the sites studied. Coefficients of variation were between 13 and 19%.

The mean values of leaf K in site-1 were found 0.96% in December '94 and 1.21% in September '95. In the following year there were 0.98% in December '95 and 1.10% in September '96. Coefficient of variation was 25% in December '94 and 19% in September '95. The values varied at a lower rate in the second year. In site-2 mean K contents were 1.20% and 1.02% in December '94 and September '95 respectively with coefficients of variation of 12 to 13%. The K values in corresponding months of the following year were 1.07% and 0.99%. The mean values of K content in site-3 for December '94, September '95, December '95 and September '96 were 1.18%, 1.09 %, 1.10% and 1.08 % respectively. Coefficients of variation were around 14% to 17%. So, the three sites had almost similar values of leaf K.

Mean leaf Ca in site-1 at December '94, September '95, December '95 and September '96 were 1.31%, 1.03%, 1.31% and 1.08% correspondingly. Thus there was generally higher leaf Ca concentration in December. In site-2, mean Ca contents in leaf were 1.46% in December '94, 1.16% in September '95, 1.58% in December '95, and 1.38% in September '96. The mean values of leaf Ca content in site-3 were 1.35% and 1.19% in December '94 and September '95 respectively. Ca concentration was 1.48% in December '95 and 1.32% in September '96. Coefficients of variation were 12% to 14% in the first year and 8% in the second year.

Mean Mg contents in leaf in site-1 varied within a narrow range 0.45% and 0.52% during the studied periods. Coefficients of variation ranged from 11% to 21%. The mean values of leaf Mg during December '94, September '95, December '95 and September '96 in site-2 were 0.56 %, 0.47 %, 0.61% and 0.55%. Coefficients of variation were within 10% to 21%. In these respective periods mean leaf Mg in site-3 were 0.59%, 0.61%, 0.60% and 0.63% with the respective coefficients of variation of 14%, 12%, 13% and 10%.

There were significant differences in foliar N during December, 94 and in P during December, 94 and September, 96 among the fertilizer treatments in site-1. In this site, leaf K, Ca and Mg did not vary significantly with treatments. However, in site-2, leaf N varied significantly among the treatments in all sampling periods. There were also significant variation in leak K except in December, 95, in Ca during September, 95 and December, 95. Leaf Mg differed with treatments only during December, 95. In site-3, leaf N varied due to treatments in December, 95 and September, 96 but P did so in September of both the years. Differences in leaf K among treatments were significant at all sampling periods, in leaf Ca only in the second year and in Mg during all periods except December, 94. Leaf N, P and K were generally higher in fertilizer treatments than in control. On the other hand, Ca and Mg did not differ appreciably between the treatments and the control. Foliar N and P values were in most cases higher during September than December, so that t-values were negative for these two nutrients at all instances. The differences were statistically significant except between December, 95 and September, 96 for N in site-1 and between December, 94 and September, 95 for P in site-3. For leaf K, however, higher values were observed in September in site-1 but lower in other sites. Leaf Ca values of December were higher than those of September in all sites and in both years of study.

Latex Production

Data of latex produced per tree per tap basis was estimated for the first, second and average of the two years in each of the treatments.

In site-1, the average yield in the control plot was 2133.33 kg/ha/yr. In the first year, latex yield ranged from 44.41 ($N_3P_3K_1$) to 77.24 cc/tree/tap ($N_3P_2K_2$). In the second year the minimum (53.37 cc/tree/tap) and the maximum yield (101.07 cc/tree/tap) were found respectively in $N_3P_3K_1$ and $N_3P_2K_1$. Average yield of the two years and expressed on hectare basis ranged from 1779.52 ($N_3P_2K_0$) to 3246.05 kg/yr ($N_3P_2K_2$). During the first year latex yield varied between 43.81 and 74.71 cc/tree/tap in site-2 respectively in $N_2P_1K_3$ and $N_2P_1K_2$. Average values for the two years were within 52.95 to 79.76 cc/tree/tap ($N_2P_1K_0$ and $N_2P_2K_1$ respectively) with mean of the average values of 65.43 cc/tree/tap. On hectare basis yield of latex varied from 1942.01 kg/yr ($N_2P_1K_3$) to 2986.21 kg/yr ($N_2P_1K_2$). Latex yield in the first year was found to vary from 47.80 (N_2 P_1 K_3) to 74.37 cc /tree/tap ($N_2P_2K_0$). In the second year the treatments $N_0P_0K_0$ and $N_1P_3K_2$ showed respectively the lowest (64.39 cc/tree/tap) and the highest yield (89.46 cc/tree/tap). The average values of two years varied from 58.78 ($N_0P_0K_0$) to 78.41 cc/tree/tap ($N_2P_2K_0$). Mean average yield of latex for two years was 67.14 cc /tree/tap. Average latex yield in the first and second year was 58.78 and 75.77 cc/tree/tap respectively. On hectare basis, latex yield differed from 2201 to 2936 kg/yr.

Analyses of variance showed that added nitrogen fertilizers in the first, second and average of both the years, brought about significant variation in latex production in site-1 individually. Potassium fertilizers individually brought out significant variation in latex yield only in the second year and in average values. NxP and NxPxK interactions had highly significant effects on latex yield in this site. In site-2 however, all the fertilizers individually and combinedly (NxP, PxK, NxK and NxPxK) affected latex yield in the second year and in average values. In the first year, individual effect of K was not significant although its interaction with N and P (PxK, NxK) were significant. In site-3 too, the individual effect of K was not significant. N and P individually and all the two way (NxP, PxK, NxK) or three way (NxPxK) interactions had significant effect on latex yield of this site. The same trend was repeated in case of the average values. In contrast, individual effects of N and P in the second year were not significant.

When the effect of one level of a fertilizer was statistically compared with another level the following main observations were noted:

In site-1:

- N_1 was significantly better than N_2 and N_3,
- After one year P_2 showed higher yield than P_0,
- K_1, K_2 and K_3 gave higher yield than K_0 but K_2 was better than other levels.

In site-2:

- Higher levels of N increased latex yield over N_0. N_3 gave considerably higher yield at all period.
- Higher levels of P increased latex yield over P_0 after one year, but positive response to P_3 was the highest.
- K_1 and K_2 gave significantly higher latex yield than K_0 after two years, and K_2 was better than K_1.

In site-3:

- N_2 gave significantly higher latex yield than N_0, N_1 and N_3 after at all periods,
- P_1 and P_2 produced higher latex than P_0 but the difference was not statistically significant.
- K_1 gave significantly higher latex yield than K_0 after two years. Other levels of K did not increase latex yield.

From the above account, it is concluded that the following fertilizer combinations are suitable for increasing latex yield:

Site-1:	$N_1 P_2 K_2$
Site-2:	$N_3 P_3 K_2$
Site-3:	$N_2 P_1 K_1$ or $N_2 P_2 K_1$

Profit/loss due to fertilizer was also estimated on the bases of total variable cost (TVC), added return, return above variable cost (RAVC) and marginal benefit cost ratio (MBCR). A negative added return i.e. loss due to fertilizer application was observed in 18, 4 and 5 treatments in site-1, site-2 and site-3 respectively. However, positive added return i.e. profit due to fertilizers ranged from Tk. 22.00 ($N_1P_3K_1$) to 18540.00 ($N_3P_1K_3$) in site-1, from Tk. 537.00 ($N_1P_2K_3$) to 18055.00 ($N_2P_1K_2$) in site- 2 and from Tk. 311.00 ($N_1P_2K_0$) to 14260.00 ($N_2P_2K_0$) in site-3. Average profits (added returns) due to fertilizers in site-1, 2 and 3 were Tk. 3762.00, 6682.00 and 5286.00 respectively against average fertilizer application costs of Tk. 1416.00 only.

MBCR ranged from -18.8 to 13.39 in site-1, -3.00 to 12.70 in site-2 and 0.98 to 11.09 in site-3. Positive MBCR values indicated a profit, while a negative MBCR likewise indicated a loss in proportion to fertilizer input. MBCR values less than 1.00 were nonprofitable. In the present experiment higher than 1.00 MBCR were observed in 37 treatments in site-1, 58 treatments in site-2 and 51 treatments in site-3. MBCR values higher than 5.00 were obtained in 22 treatments in site-1, 30 treatments in site-2 and 19 treatments in site-3.

MBCR values from all treatments were statistically tested. All the fertilizers and their combinations highly and significantly influenced the MBCR in all the sites. Pair-wise comparisons for each level of a fertilizer over its other levels showed that in all sites N_1 level gave significantly higher MBCR than the control. N_2 and N_3 levels also contributed higher to the MBCR over control in site-2 and site-3, but these levels reduced MBCR over control in site-1. However each level of nitrogen differed significantly with other in its contribution to the MBCR. It appears that N_1, N_3 and N_2 levels were better in site-1, site-2 and in site-3 respectively.

In site-2 only, P_1 gave slightly but significantly higher relative profit than the control. However, P_2 was better than P_1 and P_3 in site-1. On the other hand, P_1 and P_3 were better than P_2 in site-2. P_1 was better than P_2, and P_2 was better than P_3 in site-3. In the overall considerations P_0 was more profitable in site-1 and site-3, while P_1 was more profitable in site-2 as far as MBCR was concerned. All levels of K in site-1, K_1 and K_2 in site-2 increased the MBCR significantly. On the basis of the significant mean difference, K_1 was more preferable in site-1 and site-2. In site-3, none of the levels of K increased MBCR over control.

From Duncan's multiple range test, and based on significant differences in contribution to the MBCR, the suitable combinations were:

Site	**Estimated suitable combinations**	**Observed MBCR**
Site-1:	$N_1 P_0 K_1$	10.03
	$N_1 P_2 K_1$	8.93
Site-2:	$N_3 P_1 K_1$	5.17
	$N_3 P_0 K_1$	9.75
	$N_3 P_0 K_2$	1.75
	$N_3 P_1 K_2$	9.08
	$N_2 P_1 K_1$	9.83
	$N_2 P_0 K_1$	11.92
	$N_2 P_0 K_2$	3.53
	$N_2 P_1 K_2$	12.70
Site-3:	$N_1 P_0 K_0$	11.89
	$N_1 P_0 K_1$	2.70
	$N_1 P_1 K_0$	8.73
	$N_1 P_1 K_1$	8.12
	$N_2 P_0 K_1$	3.06
	$N_2 P_1 K_1$	6.06
	$N_2 P_0 K_0$	5.54
	$N_2 P_1 K_0$	6.17

However, the highest MBCR values were found in treatments:

Site-1: $N_3P_2K_2$ (13.39)

Site-2: $N_2P_1K_2$ (12.70)

Site-3: $N_1P_0K_0$ (11.89)

CONCLUSION

In the present study an attempt was made to observe response of mature rubber trees of Dantmara Rubber Estate to added fertilizers. Objectives of the study included whether addition of fertilizer increases latex yield and if this response could be profitable. Results indicated both the objectives positive. However, choosing a fertilizer dose for commercial plantations has to be done with caution so that long-term negative impact on both plant and soil could be apprehended well ahead. The landform, soil, tree nutrition, crop management etc. all need to be considered before any recommendation is made.

The physical, chemical and nutritional properties of the soils in Dantmara Rubber Estate indicated a low level of fertility according to agricultural standards. For this a positive response in latex production to added N, P and K fertilizers were obtained in the present investigation. However, the response differed with treatment combinations and among the sites under experimentation. Foliar N, P and K concentrations also indicated necessity of fertilizer application. The sites also differed in this respect. Foliar nutrient data exhibited that site-1 needed more K, site-2 more P and site-3 more N.

The dozes $N_1P_2K_2$, $N_3P_3K_2$ and $N_2P_1K_1$ or $N_2P_2K_1$ were found suitable for increasing latex yield in site-1, site-2 and site-3 from statistical estimation. In these treatments the observed latex yield values were close to the highest yields in corresponding sites. The treatment $N_1P_2K_2$ in site-1 gave a MBCR of 9.14, $N_3P_3K_2$ in site-2 had 8.61, and $N_2P_1K_1$ and $N_2P_2K_1$ for site-3 contributed MBCR of 6.04 and 3.89 respectively. The treatments giving the highest latex yield in site-1 and site-2 also gave the maximum MBCR (13.39 in site-1 and 12.70 in site-2). In site-3 the highest yield was obtained in $N_2P_2K_0$ but the highest MBCR was found in $N_1P_0K_0$ (11.89). Since 0 level of any fertilizer is not desirable due to the risk of fertility depletion, the suitable fertilizer dozes were $N_1P_2K_1$, $N_1P_2K_2$ and $N_3P_2K_2$ in site-1 (MBCR= 8.90, 9.14 and 13.39 respectively), $N_2P_1K_1$, $N_2P_1K_2$, $N_3P_1K_2$ and $N_3P_3K_2$ in site-2 (MBCR= 9.83, 12.70, 9.08 and 8.61 respectively) and $N_1P_1K_1$ and $N_2P_1K_1$ in site-3 (MBCR= 8.12 and 6.04 respectively). The differences in the combinations among the sites may be due to soil conditions, age of the plants and clonal variation.

The above fertilizer dozes have been selected on the basis of two years data on soil, leaf nutrient, latex yield and profitability studies in one rubber estate of Bangladesh. Even though the entire area of the estate could not be included for the present study, the findings should apply to equally under similar clone, age of trees and soil characteristics of this estate. Multi-location trial is very important in fertilizer recommendation particularly for such long duration crops. Further studies should be conducted with these fertilizer dozes in other rubber estates if soil and other land characteristics are comparable. The present findings show that carefully selected fertilizer dozes can considerably increase latex yield but very little systematic investigation has been made earlier and elsewhere in the country.

CHAPTER 6. REFERENCES

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CHAPTER 7. APPENDICES

APPENDICES

Appendix I. Natural rubber production (thousand tonnes) in different countries (Jumpasut 1997).

Name	1996	1997	1998
Bangladesh	3	3	4
Brazil	44	45	47
Cambodia	43	41	40
Cameroon	58	60	62
China	400	420	450
Cote D'lvoire	85	91	96
Gabon	8	10	12
Ghana	10	12	13
Guatemala	35	38	40
India	540	576	615
Indonesia	1543	1650	1750
Liberia	10	15	20
Malaysia	1083	1050	1000
Myanmar	20	22	23
Nigeria	91	90	89
Other Africa	5	6	7
Other Latin America	16	17	18
Papua New Guinea	7	8	8
Philippines	64	66	69
Sri Lanka	112	115	120
Thailand	1936	2018	2096
Vietnam	110	120	127
Zaire	15	16	17
Total	6250	6490	6720

Appendix II Synthetic rubber production (thousand tonnes) in different countries (Jumpasut 1997).

Name	1996	1997	1998
Argentina	58	60	65
Australia	48	49	50
Austria	5	5	5
Belgium	140	143	144
Brazil	288	295	305
Bulgaria	28	30	35
Canada	220	230	237
China	553	595	625
Czech Rep.	78	80	85
Finland	36	37	38
France	582	600	620
Germany	485	490	500
India	63	88	117
Italy	303	309	315
Japan	1520	1516	1524
Mexico	120	125	130
Netherlands	180	190	195
Other Europe	48	55	65
Poland	106	115	125
Rep. of Korea	516	601	622
Romania	35	36	40
Russian Federation	775	800	845
South Africa	58	59	60
Spain	88	93	97
Sweden	36	38	40
Taiwan	375	450	470
Turkey	50	55	57
U.K.	328	340	350
U.S.A.	2486	2516	2557
Yugoslavia	16	20	35
Total	**9620**	**10020**	**10350**

Appendix III. Distribution of *Hevea* clones in the Rubber Estates of BFIDC (Anderson and Chamlers 1985)

Estates	Clones	Area (ha)	Planting periods	Total area (ha)
Dantmara	TJIR-1	362	1970-74	
	PBIG/GGP	243	1980-82	
	RRIM-600	191	1982-83	1216
	BIG+RRIM-600+PB-235	197	1984-85	
	GT-I+RRIM-600+PB-235	223	1985-86	
Dabua	TJIR-1	303	1969-72	
	RRIM-600	166	1982-83	715
	RRIM-600+PBIG/GG	121	1983-84	
	RRIM-600+PB-235	124	1984-85	
Holudia	RRIM-600	123	1982-83	
	RRIM-600+PBIG+GT-I	263	1983-84	589
	RRIM-600+GT-+PB-235	202	1984-85	
Kanchan Nagar	RRIM-600	121	1982-83	
	RRIM-600+PBIG/GG	171	1983-84	454
	RRIM-600 + GT-I+PB-235	162	1984-85	
Raojan	TJIR-1	469	1960-65	554
	RRIM-600	85	1983-84	
Ramu	Not known		1960-80	
Tarakhoan	RRIM-600	81	1982-83	
	RRIM-600+PBIG	121	1983-84	364
	RRIM-600+PB-235	162	1984-85	
Sahazibazar	Unknown Source	23	1979-80	524
	RRIM-600	298	1982-83	
	PBIG/GG	81	1983-84	
	RRIM-600+GT-I+PB-235	121	1984-85	
Bhatera	TJIR-1	423	1966-78	
	PBIG/GG	115	1979-82	730
	RRIM-600+PBIG/GG	170	1983-84	
	PBIG/GG+RRIM-600+GT-I	22	1984-85	
Rupaichara	Unknown	65	1977-78	
	PBIG	81	1981-82	746
	PBIG/GGR	53	19983-84	
	RIM-600	547	1982-85	
Satgoan	TJIR-1	355	1976-77	
	RRIM-600	240	1982-83	695
	PBIG/GG	99	1984-85	
Sherpur Tangail	TJIR-1+ RRIM-600+PB-235	324	1991-92	607
Madhupur	RRIM-600+GT-1+PB-235	283	1987-88	283

Appendix IV. Survival percentage of rubber trees in different estates of the eastern regions of Bangladesh.

Name of the estate	Period	Area (ha)	Trees planted		Trees survived at present		After rehabilitation (tree/ha)
			Total No.	Per ha.		Per ha.	
Dantmara	Pre- ADB (1969-80)	299	133020	445	38941	131	222
	During ADB (1980-89)	1248	509097	408	107805	86	
	Rehabilitation(1993-95)	-	205266	-	196936	-	
Sub-total	-	1547	-	-	343682	-	-
Kanchan Nagar	Pre- ADB	-	-	-	-	-	279
	During ADB (1980-89)	956	328794	343	89291	94	
	Rehabilitation (1993-5)	-	178123	-	178723	-	
Sub-total	-	956	-	-	267414	-	-
Tarakhon	Pre- ADB	-	-	-	-	-	282
	During ADB(1980-89)	986	295465	400	124411	126	
	Rehabilitation(1993-95)	-	154663	-	154663	-	
Sub-total	-	986	-	-	279174	-	-
Dabua		287	127623	403	27699	131	210
	During ADB(1980-89)	555	225428	-	24710	45	
	Rehabilitation(1993-95)	-	115871	-	115871	-	
Sub-total	-	842	-	-	178280	-	-
Holudia	Pre ADB	-	-	400	-	-	230
	During ADB(1980-89)	909	365188	-	116966	128	
	Rehabilitation(1993-95)	-	100862	-	92972	-	
Sub-total	-	909	-	450	209938	-	-
Raozan	Pre ADB (1969-80)	465	208485	358	67885	146	284
	During ADB(1980-89)	81	29020	-	8070	99	
	Rehabilitation(1993-95)	-	243564	-	78735	-	
Sub-total	-	456	-	-			25%

Appendix V. Total area under extraction and production (latex) potential of different estates during 1994 - 95.

Name of the Rubber Estate	Total planted area (ha)	Total collection of latex (kg)	Collection of latex (kg / tree)		Collection of latex (kg/ha)		Total area under collection		Real production potential from total planted area (kg / year)	
			Avg	Max	Avg	Max	(ha)	%**	Avg	Max
Dantmara	1547	752964	5.22	6.36	2065	2513	365	24	3191299	-3888250
Kanchan Nagar	956	297806	4.42	6.22	1747	2458	170	18	1669699	-2349667
Tarakhon	986	284121	3.31	5.50	1308	1680	217	22	1290105	-2143680
Dabua	842	467834	6.93	8.13	2739	3213	171	20	2317392	-2718672
Holudia	909	357372	3.43	5.28	1356	2087	264	29	1231605	-1897421
Raozan	54	9450	6.44	8.14	545	3217	446 (181)	33	1388979	1755635

* 160 trees/acre have been considered for the collection of latex per/ha, ** Average rate of latex collection of total area.

Appendix VI. Proforma for physiognomical status of trees in the experimental sites.

Plantation:______ Site:___ Block:___ Date of data location:______

SL No. of plots	Treatments	Girth (cm) at 1.3m	Average girth (cm)	Status of trees*			
				B	C	D	W

*Physical status of trees (%):
B = Broken branch,
C = Crown damaged,
D = Partly deformed in the tapping zone,
W =Normal

Signature of the Investigator

Appendix VII. A brief list of identified weeds/grasses/ creepers etc. in the experimental sites.

Local name	**Botanical name**	**Family name**
Lantana/Kada Asam	*Lantana camera* L.	Verbinaceae
Bhaitgach/Bhat/Veck gach	*Clerodendron viscosum* Vent.	Verbinaceae
Asam Lata	*Eupatorium odoratum* L.	Compositae
Lajjabati/Lajurickh	*Mimosa pudica* L.	Leguminosae
Pakistani Ludi/Ludi Azam	*Mikania micrantha*	Compositae
Jangli seem	*Canavalia virosa* W .& A.	Leguminosae
Nal khagra/Khagra/Bulong	*Sacharum spontaneum* L.	Gramineae
Dhekisak like weeds	*Lycopodium* spp. *Neprolepsis* spp.	Fern
Pakpakgula	*Passiflora foetida* L.	Passifloraceae
Magpittang gula	*Melastoma melabatricum* L.	Melastomaceae
Kumari lata	*Smilax macrophylla* Roxb. *Smilax Zeylanica* L.	Smilacaceae
Gila lata	*Entata phaseoloides* (L.) Merr.	Leguminosae
Manakata/Mankata	*Xeromphis spinosa*	Rubiaceae
Miscellaneous	Unknown species	Unknown

Appendix VIII. Average of climatic data of the experimental sites from 1991-96 (Source: Dantmara Rubber Estate).

Parameter	J	F	M	A	M	J	J	A	S	O	N	D	Yearly
Rainfall, mm	10.58	54.95	119.14	185.95	311.61	440.95	386.05	439.0	261.62	156.86	71.61	6.40	Total 23.80
Humidity max. %	82.25	88.00	86.80	85.20	87.40	90.00	90.80	90.20	87.20	90.80	90.20	80.60	Av. 88%
Humidity min. %	66.00	68.20	64.40	66.20	65.20	65.80	68.60	69.20	70.4	67.80	67.80	63.80	Av. 67%
Temp. °C max.	23.94	26.62	31.49	32.41	33.37	31.05	31.82	32.23	32.12	31.80	28.58	26.15	Av. 30.00
Temp. °C min.	10.25	13.86	20.01	21.71	21.27	22.68	23.07	22.08	22.07	23.19	18.76	12.27	Av. 19.00

Appendix IX. Number of rainy days at different months in Dantmara Rubber Estate during 1991-96 (Source: Dantmara Rubber Estate).

Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
1991	1	2	3	9	19	17	18	9	16	8	1	3	106
1992	0	6	0	1	10	9	12	12	11	6	0	1	68
1993	0	3	5	10	16	16	17	26	12	7	1	0	113
1994	0	1	6	12	13	25	15	23	17	6	2	0	120
1995	0	4	2	3	10	18	17	18	14	6	9	0	101
1996	1	1	3	3	5	12	12	17	14	10	2	0	80
Avg.	0.3	2.8	3.17	6.3	12.2	16.2	15.2	17.50	14	7.17	2.50	0.67	98
SD±	0.5	2.0	2.14	4.5	4.96	5.5	2.6	6.41	2.28	1.60	3.27	1.21	20.41
CV%	158	69	68	70	41	34	17	37	16	22	131	181	20

Appendix X. Proforma for compiling latex yield data indicating distribution of treatments in block and their latex yield/tree/tap.

Plantation:__________ **Site:**___ **Block:**___ **Month:**_________ **Year:**_____

Sl No.	Treatment	Block – 1		Block – 2		Block – 3		Average latex cc/tree/day
		Tag No.	Latex (cc)	Tag No.	Latex (cc)	Tag No.	Latex (cc)	
1	$N_0P_0K_0$	9		11		38		
2	$N_0P_0K_1$	19		21		26		
3	$N_0P_0K_2$	61		4		37		
4	$N_0P_0K_3$	34		49		6		
5	$N_0P_1K_0$	5		1		23		
6	$N_0P_1K_1$	41		51		30		
7	$N_0P_1K_2$	13		3		45		
8	$N_0P_1K_3$	62		26		14		
9	$N_0P_2K_0$	60		33		44		
10	$N_0P_2K_1$	54		40		56		
11	$N_0P_2K_2$	28		13		19		
12	$N_0P_2K_3$	30		14		48		
13	$N_0P_3K_0$	10		20		62		
14	$N_0P_3K_1$	59		64		31		
15	$N_0P_3K_2$	43		5		61		
16	$N_0P_3K_3$	50		19		58		
17	$N_1P_0K_0$	16		23		17		
18	$N_1P_0K_1$	57		17		1		
19	$N_1P_0K_2$	29		39		46		
20	$N_1P_0K_3$	58		18		57		
21	$N_1P_1K_0$	20		2		52		
22	$N_1P_1K_1$	22		32		20		
23	$N_1P_1K_2$	49		35		21		
24	$N_1P_1K_3$	45		43		41		
25	$N_1P_2K_0$	44		45		59		
26	$N_1P_2K_1$	47		31		32		
27	$N_1P_2K_2$	36		44		51		
28	$N_1P_2K_3$	3		48		63		
29	$N_1P_3K_0$	46		47		3		
30	$N_1P_3K_1$	51		37		39		

Contd. Appendix X

Sl No.	Treatment	Rep.-1		Rep.-2		Rep.-3		Average latex cc/tree/day
		Tag No.	Latex (cc)	Tag No.	Latex (cc)	Tag No.	Latex (cc)	
31	$N_1P_3K_2$	42		52		15		
32	$N_1P_3K_3$	64		41		27		
33	$N_2P_0K_0$	32		8		28		
34	$N_2P_0K_1$	48		7		34		
35	$N_2P_0K_2$	18		59		10		
36	$N_2P_0K_3$	1		27		54		
37	$N_2P_1K_0$	53		54		25		
38	$N_2P_1K_1$	52		58		60		
39	$N_2P_1K_2$	14		9		13		
40	$N_2P_1K_3$	21		46		64		
41	$N_2P_2K_0$	11		22		16		
42	$N_2P_2K_1$	15		16		40		
43	$N_2P_2K_2$	35		30		2		
44	$N_2P_2K_3$	40		61		4		
45	$N_2P_3K_0$	38		50		50		
46	$N_2P_3K_1$	25		36		35		
47	$N_2P_3K_2$	63		55		24		
48	$N_2P_3K_3$	33		60		11		
49	$N_3P_0K_0$	7		57		49		
50	$N_3P_0K_1$	17		10		53		
51	$N_3P_0K_2$	37		25		42		
52	$N_3P_0K_3$	31		42		22		
53	$N_3P_1K_0$	27		12		29		
54	$N_3P_1K_1$	39		56		33		
55	$N_3P_1K_2$	55		28		5		
56	$N_3P_1K_3$	24		62		9		
57	$N_3P_2K_0$	6		15		12		
58	$N_3P_2K_1$	4		24		8		
59	$N_3P_2K_2$	2		34		36		
60	$N_3P_2K_3$	8		6		7		
61	$N_3P_3K_0$	56		38		47		
62	$N_3P_3K_1$	12		29		55		
63	$N_3P_3K_2$	23		63		43		
64	$N_3P_3K_3$	26		53		18		

Signature of Investigator

Appendix XI. ANOVA for gbh of *H. brasiliensis* in the studied sites.

Parameter	Source of variation	Sum of squares	df	Mean squares	F
GBH of site-1	Treatment	4696.260	63	74.544	0.927 ns
	Residual	10294.553	128	80.426	
	Total	14990.813	191		
GBH of site-2	Treatment	1896.953	63	30.110	0.972 ns
	Residual	3964.613	128	30.974	
	Total	5861.566	191		
GBH of site-3	Treatment	776.126	63	12.319	0.654 ns
	Residual	2411.333	128	18.839	
	Total	3187.459	191		

ns= not significant.

Appendix XII. Total nitrogen concentration (%) in soil after 90 days of fertilizer application (i.e. December, 94).

SL	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
1	$N_0P_0K_0$	0.09	0.08	0.12	0.09	0.09	0.10
2	$N_0P_0K_1$	0.08	0.08	0.11	0.08	0.08	0.08
3	$N_0P_0K_2$	0.08	0.08	0.12	0.09	0.08	0.08
4	$N_0P_0K_3$	0.09	0.07	0.09	0.08	0.07	0.06
5	$N_0P_1K_0$	0.08	0.07	0.10	0.08	0.08	0.07
6	$N_0P_1K_1$	0.08	0.07	0.08	0.06	0.08	0.07
7	$N_0P_1K_2$	0.08	0.08	0.08	0.07	0.08	0.07
8	$N_0P_1K_3$	0.09	0.07	0.08	0.08	0.09	0.07
9	$N_0P_2K_0$	0.08	0.07	0.10	0.06	0.08	0.06
10	$N_0P_2K_1$	0.10	0.08	0.10	0.07	0.09	0.08
11	$N_0P_2K_2$	0.08	0.08	0.09	0.08	0.09	0.07
12	$N_0P_2K_3$	0.09	0.07	0.08	0.07	0.08	0.08
13	$N_0P_3K_0$	0.08	0.07	0.09	0.06	0.08	0.06
14	$N_0P_3K_1$	0.08	0.06	0.09	0.07	0.10	0.08
15	$N_0P_3K_2$	0.08	0.07	0.09	0.07	0.09	0.07
16	$N_0P_3K_3$	0.08	0.07	0.08	0.06	0.08	0.06
17	$N_1P_0K_0$	0.08	0.06	0.09	0.07	0.09	0.07
18	$N_1P_0K_1$	0.09	0.07	0.09	0.08	0.08	0.06
19	$N_1P_0K_2$	0.08	0.06	0.08	0.07	0.09	0.08
20	$N_1P_0K_3$	0.08	0.07	0.09	0.06	0.08	0.07
21	$N_1P_1K_0$	0.08	0.07	0.08	0.07	0.09	0.06
22	$N_1P_1K_1$	0.09	0.08	0.09	0.06	0.08	0.08
23	$N_1P_1K_2$	0.09	0.08	0.10	0.07	0.07	0.08
24	$N_1P_1K_3$	0.07	0.08	0.09	0.06	0.08	0.06
25	$N_1P_2K_0$	0.08	0.07	0.10	0.07	0.07	0.06
26	$N_1P_2K_1$	0.08	0.08	0.09	0.06	0.09	0.07
27	$N_1P_2K_2$	0.09	0.07	0.08	0.06	0.08	0.07
28	$N_1P_2K_3$	0.08	0.06	0.09	0.07	0.07	0.06
29	$N_1P_3K_0$	0.08	0.06	0.08	0.07	0.09	0.07
30	$N_1P_3K_1$	0.09	0.08	0.09	0.06	0.08	0.06

Contd. Appendix XII.

SL	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
31	$N_1P_3K_2$	0.08	0.08	0.11	0.07	0.09	0.08
32	$N_1P_3K_3$	0.08	0.06	0.12	0.08	0.09	0.07
33	$N_2P_0K_0$	0.08	0.06	0.10	0.09	0.08	0.08
34	$N_2P_0K_1$	0.07	0.07	0.11	0.08	0.09	0.07
35	$N_2P_0K_2$	0.08	0.08	0.09	0.08	0.09	0.08
36	$N_2P_0K_3$	0.09	0.07	0.09	0.07	0.08	0.06
37	$N_2P_1K_0$	0.08	0.07	0.12	0.09	0.10	0.07
38	$N_2P_1K_1$	0.08	0.07	0.13	0.10	0.10	0.09
39	$N_2P_1K_2$	0.09	0.08	0.12	0.09	0.09	0.07
40	$N_2P_1K_3$	0.10	0.07	0.12	0.08	0.10	0.08
41	$N_2P_2K_0$	0.09	0.06	0.09	0.06	0.09	0.06
42	$N_2P_2K_1$	0.08	0.08	0.08	0.06	0.11	0.07
43	$N_2P_2K_2$	0.10	0.08	0.13	0.08	0.12	0.06
44	$N_2P_2K_3$	0.12	0.07	0.12	0.10	0.13	0.09
45	$N_2P_3K_0$	0.09	0.07	0.11	0.08	0.10	0.06
46	$N_2P_3K_1$	0.09	0.08	0.10	0.07	0.11	0.08
47	$N_2P_3K_2$	0.09	0.10	0.12	0.08	0.12	0.07
48	$N_2P_3K_3$	0.13	0.09	0.11	0.06	0.11	0.08
49	$N_3P_0K_0$	0.13	0.08	0.13	0.07	0.14	0.07
50	$N_3P_0K_1$	0.12	0.09	0.12	0.08	0.10	0.09
51	$N_3P_0K_2$	0.11	0.08	0.13	0.07	0.11	0.08
52	$N_3P_0K_3$	0.14	0.07	0.11	0.08	0.10	0.09
53	$N_3P_1K_0$	0.13	0.06	0.10	0.09	0.11	0.06
54	$N_3P_1K_1$	0.09	0.08	0.09	0.08	0.12	0.08
55	$N_3P_1K_2$	0.13	0.11	0.10	0.08	0.11	0.06
56	$N_3P_1K_3$	0.13	0.10	0.11	0.07	0.12	0.07
57	$N_3P_2K_0$	0.12	0.09	0.12	0.04	0.09	0.08
58	$N_3P_2K_1$	0.15	0.08	0.13	0.06	0.10	0.08
59	$N_3P_2K_2$	0.14	0.07	0.13	0.07	0.13	0.06
60	$N_3P_2K_3$	0.13	0.08	0.14	0.06	0.11	0.08
61	$N_3P_3K_0$	0.14	0.09	0.13	0.06	0.12	0.08
62	$N_3P_3K_1$	0.11	0.08	0.14	0.07	0.11	0.09
63	$N_3P_3K_2$	0.12	0.06	0.11	0.08	0.11	0.10
64	$N_3P_3K_3$	0.15	0.09	0.12	0.07	0.12	0.09
Mean		0.10	0.08	0.10	0.07	0.10	0.07
%CV		20	13	20	14	20	14

Appendix XIII. Available P concentration (ppm) in soil after 90 days of fertilizer application (i.e. December, 94).

SL	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
1	$N_0P_0K_0$	25	18	24	20	27	17
2	$N_0P_0K_1$	22	19	20	22	20	19
3	$N_0P_0K_2$	20	21	23	19	22	18
4	$N_0P_0K_3$	23	25	20	16	24	16
5	$N_0P_1K_0$	24	23	22	18	23	20
6	$N_0P_1K_1$	23	14	20	18	14	20
7	$N_0P_1K_2$	22	19	21	16	24	16
8	$N_0P_1K_3$	20	12	20	14	21	17
9	$N_0P_2K_0$	25	19	23	20	22	14
10	$N_0P_2K_1$	24	18	20	16	24	21
11	$N_0P_2K_2$	21	20	19	20	23	13
12	$N_0P_2K_3$	27	21	21	20	24	10
13	$N_0P_3K_0$	29	20	24	20	21	18
14	$N_0P_3K_1$	29	19	25	24	26	17
15	$N_0P_3K_2$	28	18	30	21	24	21
16	$N_0P_3K_3$	26	16	24	20	22	25
17	$N_1P_0K_0$	20	23	21	22	17	19
18	$N_1P_0K_1$	21	22	20	13	18	20
19	$N_1P_0K_2$	24	21	14	13	17	21
20	$N_1P_0K_3$	16	18	18	14	19	12
21	$N_1P_1K_0$	24	17	24	18	22	19
22	$N_1P_1K_1$	21	19	20	14	22	21
23	$N_1P_1K_2$	21	22	21	20	20	18
24	$N_1P_1K_3$	20	23	21	16	24	14
25	$N_1P_2K_0$	19	18	20	16	30	12
26	$N_1P_2K_1$	20	13	24	17	17	19
27	$N_1P_2K_2$	19	18	23	14	21	14
28	$N_1P_2K_3$	19	17	22	11	26	24
29	$N_1P_3K_0$	30	16	19	23	28	23
30	$N_1P_3K_1$	38	14	26	24	26	21

Contd. Appendix XIII.

L	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
31	$N_1P_3K_2$	24	23	24	25	21	22
32	$N_1P_3K_3$	24	19	25	19	22	23
33	$N_2P_0K_0$	20	21	21	24	24	20
34	$N_2P_0K_1$	20	22	19	22	20	13
35	$N_2P_0K_2$	21	19	18	15	24	14
36	$N_2P_0K_3$	19	14	22	17	25	17
37	$N_2P_1K_0$	20	13	21	13	25	18
38	$N_2P_1K_1$	25	18	23	18	19	14
39	$N_2P_1K_2$	24	20	22	16	18	13
40	$N_2P_1K_3$	21	19	21	14	22	12
41	$N_2P_2K_0$	26	13	25	19	22	20
42	$N_2P_2K_1$	27	19	26	23	24	21
43	$N_2P_2K_2$	28	16	26	23	20	18
44	$N_2P_2K_3$	31	20	33	18	24	23
45	$N_2P_3K_0$	26	21	25	24	24	19
46	$N_2P_3K_1$	25	23	28	18	19	22
47	$N_2P_3K_2$	24	25	25	19	21	20
48	$N_2P_3K_3$	24	28	28	23	24	22
49	$N_3P_0K_0$	22	19	20	14	22	23
50	$N_3P_0K_1$	19	13	21	22	24	20
51	$N_3P_0K_2$	18	17	24	13	25	16
52	$N_3P_0K_3$	19	22	25	17	24	14
53	$N_3P_1K_0$	20	14	22	13	25	16
54	$N_3P_1K_1$	23	14	25	18	20	24
55	$N_3P_1K_2$	25	19	23	17	21	16
56	$N_3P_1K_3$	25	14	26	18	24	19
57	$N_3P_2K_0$	20	17	22	20	24	14
58	$N_3P_2K_1$	21	15	22	21	20	17
59	$N_3P_2K_2$	25	17	28	18	23	21
60	$N_3P_2K_3$	28	25	24	17	20	17
61	$N_3P_3K_0$	28	17	25	22	21	25
62	$N_3P_3K_1$	25	24	24	26	24	23
63	$N_3P_3K_2$	29	19	26	24	24	25
64	$N_3P_3K_3$	24	22	23	19	25	21
Mean		23	19	23	19	22	18
%CV		16	19	14	19	13	21

Appendix XIV. Available K concentration (me/100g) in soil after 90 days of fertilizer application (i.e. December, 94).

SL	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
1	$N_0P_0K_0$	0.10	0.17	0.20	0.18	0.32	0.15
2	$N_0P_0K_1$	0.18	0.16	0.35	0.23	0.25	0.32
3	$N_0P_0K_2$	0.22	0.18	0.36	0.31	0.25	0.16
4	$N_0P_0K_3$	0.20	0.18	0.21	0.17	0.33	0.28
5	$N_0P_1K_0$	0.17	0.16	0.16	0.14	0.20	0.14
6	$N_0P_1K_1$	0.20	0.18	0.23	0.20	0.22	0.16
7	$N_0P_1K_2$	0.35	0.31	0.19	0.13	0.33	0.36
8	$N_0P_1K_3$	0.22	0.15	0.38	0.25	0.33	0.30
9	$N_0P_2K_0$	0.14	0.11	0.20	0.22	0.17	0.12
10	$N_0P_2K_1$	0.22	0.19	0.36	0.26	0.20	0.32
11	$N_0P_2K_2$	0.22	0.16	0.36	0.24	0.33	0.30
12	$N_0P_2K_3$	0.41	0.19	0.27	0.18	0.37	0.13
13	$N_0P_3K_0$	0.12	0.13	0.23	0.19	0.17	0.13
14	$N_0P_3K_1$	0.15	0.12	0.29	0.22	0.33	0.17
15	$N_0P_3K_2$	0.39	0.22	0.30	0.26	0.31	0.33
16	$N_0P_3K_3$	0.35	0.34	0.35	0.31	0.36	0.29
17	$N_1P_0K_0$	0.15	0.18	0.21	0.17	0.21	0.25
18	$N_1P_0K_1$	0.21	0.14	0.24	0.21	0.34	0.12
19	$N_1P_0K_2$	0.30	0.26	0.37	0.31	0.36	0.18
20	$N_1P_0K_3$	0.20	0.20	0.35	0.26	0.28	0.28
21	$N_1P_1K_0$	0.11	0.12	0.17	0.15	0.18	0.14
22	$N_1P_1K_1$	0.21	0.16	0.39	0.31	0.30	0.19
23	$N_1P_1K_2$	0.23	0.30	0.39	0.34	0.35	0.16
24	$N_1P_1K_3$	0.34	0.22	0.23	0.20	0.38	0.32
25	$N_1P_2K_0$	0.10	0.15	0.21	0.18	0.19	0.17
26	$N_1P_2K_1$	0.22	0.19	0.23	0.19	0.28	0.14
27	$N_1P_2K_2$	0.19	0.19	0.39	0.27	0.36	0.21
28	$N_1P_2K_3$	0.21	0.22	0.36	0.25	0.30	0.30
29	$N_1P_3K_0$	0.13	0.12	0.19	0.14	0.20	0.18
30	$N_1P_3K_1$	0.14	0.11	0.19	0.13	0.29	0.36

Contd. Appendix XIV.

SL	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
31	$N_1P_3K_2$	0.39	0.17	0.05	0.12	0.32	0.28
32	$N_1P_3K_3$	0.32	0.32	0.26	0.21	0.21	0.38
33	$N_2P_0K_0$	0.19	0.12	0.17	0.11	0.24	0.19
34	$N_2P_0K_1$	0.38	0.17	0.33	0.30	0.26	0.20
35	$N_2P_0K_2$	0.13	0.11	0.36	0.29	0.36	0.20
36	$N_2P_0K_3$	0.29	0.18	0.35	0.24	0.36	0.28
37	$N_2P_1K_0$	0.09	0.09	0.19	0.15	0.17	0.14
38	$N_2P_1K_1$	0.16	0.12	0.27	0.23	0.39	0.36
39	$N_2P_1K_2$	0.13	0.13	0.25	0.18	0.34	0.17
40	$N_2P_1K_3$	0.35	0.20	0.31	0.26	0.36	0.25
41	$N_2P_2K_0$	0.21	0.14	0.23	0.17	0.16	0.14
42	$N_2P_2K_1$	0.39	0.19	0.40	0.32	0.49	0.28
43	$N_2P_2K_2$	0.32	0.18	0.35	0.25	0.36	0.19
44	$N_2P_2K_3$	0.32	0.16	0.30	0.24	0.39	0.20
45	$N_2P_3K_0$	0.13	0.27	0.18	0.14	0.17	0.14
46	$N_2P_3K_1$	0.27	0.20	0.27	0.21	0.35	0.26
47	$N_2P_3K_2$	0.22	0.16	0.27	0.23	0.34	0.24
48	$N_2P_3K_3$	0.35	0.29	0.34	0.30	0.35	0.24
49	$N_3P_0K_0$	0.33	0.21	0.30	0.22	0.20	0.17
50	$N_3P_0K_1$	0.36	0.13	0.29	0.23	0.39	0.08
51	$N_3P_0K_2$	0.37	0.17	0.38	0.32	0.30	0.23
52	$N_3P_0K_3$	0.35	0.31	0.19	0.14	0.34	0.28
53	$N_3P_1K_0$	0.26	0.16	0.35	0.28	0.25	0.13
54	$N_3P_1K_1$	0.21	0.14	0.24	0.18	0.28	0.18
55	$N_3P_1K_2$	0.16	0.11	0.23	0.18	0.37	0.25
56	$N_3P_1K_3$	0.15	0.17	0.31	0.23	0.26	0.18
57	$N_3P_2K_0$	0.15	0.15	0.19	0.14	0.21	0.15
58	$N_3P_2K_1$	0.10	0.14	0.38	0.31	0.33	0.32
59	$N_3P_2K_2$	0.39	0.23	0.34	0.27	0.31	0.24
60	$N_3P_2K_3$	0.17	0.16	0.35	0.24	0.33	0.29
61	$N_3P_3K_0$	0.15	0.18	0.23	0.18	0.17	0.18
62	$N_3P_3K_1$	0.33	0.15	0.35	0.31	0.26	0.14
63	$N_3P_3K_2$	0.31	0.13	0.35	0.28	0.33	0.20
64	$N_3P_3K_3$	0.34	0.25	0.35	0.24	0.32	0.25
Mean		0.24	0.18	0.28	0.22	0.29	0.22
%CV		38	33	29	27	24	32

Appendix XV. Available Ca concentration (me/100g) in soil after 90 days of fertilizer application (i.e. December '94).

SL	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
1	$N_0P_0K_0$	1.16	1.82	2.01	2.08	3.40	2.37
2	$N_0P_0K_1$	1.77	1.96	1.87	1.66	2.98	2.26
3	$N_0P_0K_2$	2.45	1.74	1.67	1.09	4.04	2.76
4	$N_0P_0K_3$	1.74	1.89	1.99	1.67	4.40	3.32
5	$N_0P_1K_0$	2.74	7.75	3.00	1.88	2.94	1.96
6	$N_0P_1K_1$	2.07	4.63	2.04	3.14	3.05	2.03
7	$N_0P_1K_2$	1.42	3.56	1.77	1.98	2.66	3.16
8	$N_0P_1K_3$	2.07	2.19	2.16	1.77	1.83	4.39
9	$N_0P_2K_0$	2.93	2.23	2.66	1.79	3.17	2.15
10	$N_0P_2K_1$	2.88	2.40	1.88	2.22	2.63	1.99
11	$N_0P_2K_2$	1.56	2.05	2.04	1.98	2.48	5.29
12	$N_0P_2K_3$	2.75	2.48	2.23	2.13	3.07	3.02
13	$N_0P_3K_0$	3.64	1.90	3.07	2.11	3.01	2.95
14	$N_0P_3K_1$	3.15	2.29	3.10	1.98	2.09	3.33
15	$N_0P_3K_2$	2.81	2.77	1.93	2.21	2.76	3.66
16	$N_0P_3K_3$	2.02	4.76	1.67	3.78	2.37	3.16
17	$N_1P_0K_0$	1.32	5.25	1.46	1.87	2.41	2.10
18	$N_1P_0K_1$	1.20	1.82	1.37	2.02	2.80	2.54
19	$N_1P_0K_2$	1.68	6.27	1.78	1.39	4.40	4.28
20	$N_1P_0K_3$	2.41	5.57	1.47	1.96	2.32	2.45
21	$N_1P_1K_0$	1.84	2.21	1.38	2.15	2.83	1.83
22	$N_1P_1K_1$	1.81	4.68	1.87	3.87	2.90	2.70
23	$N_1P_1K_2$	2.31	2.50	1.76	2.11	2.30	1.41
24	$N_1P_1K_3$	2.10	2.79	2.19	1.77	2.57	2.26
25	$N_1P_2K_0$	1.52	2.85	1.95	2.14	2.79	2.22
26	$N_1P_2K_1$	2.29	2.39	2.08	2.00	3.08	2.20
27	$N_1P_2K_2$	1.47	2.42	1.71	1.58	3.92	2.74
28	$N_1P_2K_3$	2.35	3.42	3.01	2.55	3.71	3.48
29	$N_1P_3K_0$	2.22	1.70	3.05	1.87	2.87	2.59
30	$N_1P_3K_1$	2.02	2.18	2.43	2.10	3.62	5.50

Contd. Appendix XV.

SL	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
31	$N_1P_3K_2$	4.40	6.06	3.18	2.14	3.21	2.55
32	$N_1P_3K_3$	2.67	4.50	3.08	2.01	3.63	2.85
33	$N_2P_0K_0$	2.45	1.64	2.01	1.98	3.63	2.73
34	$N_2P_0K_1$	1.76	5.49	1.67	1.74	3.52	2.38
35	$N_2P_0K_2$	1.42	1.64	1.72	1.67	3.00	2.32
36	$N_2P_0K_3$	1.39	2.10	1.18	1.28	2.99	2.53
37	$N_2P_1K_0$	1.66	1.89	1.72	1.37	2.34	2.07
38	$N_2P_1K_1$	2.14	3.14	2.00	2.04	2.99	2.53
39	$N_2P_1K_2$	1.39	1.89	1.98	1.73	2.77	1.76
40	$N_2P_1K_3$	3.68	4.57	2.59	1.74	2.65	1.40
41	$N_2P_2K_0$	4.09	7.25	2.15	2.49	2.17	2.79
42	$N_2P_2K_1$	2.38	5.77	2.41	3.92	3.23	5.01
43	$N_2P_2K_2$	2.25	2.59	2.47	2.16	3.04	4.38
44	$N_2P_2K_3$	1.51	2.21	2.25	2.18	2.39	3.34
45	$N_2P_3K_0$	2.30	2.94	2.98	2.37	2.99	2.93
46	$N_2P_3K_1$	3.49	4.92	3.58	3.14	3.32	2.91
47	$N_2P_3K_2$	3.90	4.42	3.67	2.43	4.40	5.47
48	$N_2P_3K_3$	3.98	6.38	3.48	3.91	4.40	3.58
49	$N_3P_0K_0$	1.69	2.23	1.46	1.32	3.16	2.96
50	$N_3P_0K_1$	1.64	2.32	1.68	1.14	2.95	1.71
51	$N_3P_0K_2$	1.77	2.00	1.71	1.42	3.66	2.75
52	$N_3P_0K_3$	1.52	2.58	1.65	1.98	3.69	2.72
53	$N_3P_1K_0$	1.73	1.92	1.59	1.67	3.41	2.78
54	$N_3P_1K_1$	2.23	2.92	1.42	1.38	2.53	1.79
55	$N_3P_1K_2$	2.49	2.39	1.19	2.40	3.56	2.03
56	$N_3P_1K_3$	1.71	3.72	3.13	2.48	2.31	1.73
57	$N_3P_2K_0$	2.52	2.75	2.17	2.98	3.18	4.04
58	$N_3P_2K_1$	1.87	3.64	1.78	2.56	4.40	3.39
59	$N_3P_2K_2$	2.83	2.43	2.45	2.67	4.41	5.50
60	$N_3P_2K_3$	1.28	2.51	1.62	2.18	4.17	5.50
61	$N_3P_3K_0$	2.44	2.87	1.95	2.14	2.41	3.09
62	$N_3P_3K_1$	2.63	1.80	2.16	2.12	2.89	3.07
63	$N_3P_3K_2$	2.98	1.86	3.17	3.71	3.16	2.98
64	$N_3P_3K_3$	2.18	5.86	2.15	3.88	2.22	2.43
Mean		2.25	3.21	2.16	2.17	3.10	2.94
%CV		34	49	29	31	21	35

Appendix XVI. Available Mg concentration (me/100g) in soil after 90 days of fertilizer application (i.e. December, 94).

SL	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
1	$N_0P_0K_0$	0.19	0.23	0.29	0.20	0.36	0.22
2	$N_0P_0K_1$	0.21	0.25	0.29	0.19	0.29	0.24
3	$N_0P_0K_2$	0.29	0.24	0.21	0.17	0.36	0.25
4	$N_0P_0K_3$	0.23	0.20	0.25	0.28	0.36	0.25
5	$N_0P_1K_0$	0.32	0.36	0.19	0.14	0.37	0.23
6	$N_0P_1K_1$	0.21	0.31	0.26	0.17	0.36	0.23
7	$N_0P_1K_2$	0.20	0.40	0.50	0.18	0.24	0.27
8	$N_0P_1K_3$	0.25	0.23	0.18	0.23	0.48	0.38
9	$N_0P_2K_0$	0.23	0.26	0.31	0.18	0.42	0.23
10	$N_0P_2K_1$	0.29	0.24	0.27	0.13	0.34	0.22
11	$N_0P_2K_2$	0.23	0.22	0.24	0.17	0.23	0.26
12	$N_0P_2K_3$	0.26	0.25	0.39	0.24	0.31	0.26
13	$N_0P_3K_0$	0.27	0.33	0.25	0.20	0.39	0.227
14	$N_0P_3K_1$	0.28	0.29	0.18	0.12	0.25	0.17
15	$N_0P_3K_2$	0.26	0.57	0.29	0.17	0.26	0.15
16	$N_0P_3K_3$	0.26	0.20	0.22	0.20	0.25	0.23
17	$N_1P_0K_0$	0.23	0.26	0.27	0.17	0.33	0.22
18	$N_1P_0K_1$	0.21	0.18	0.34	0.25	0.36	0.27
19	$N_1P_0K_2$	0.27	0.33	0.31	0.21	0.51	0.25
20	$N_1P_0K_3$	0.25	0.24	0.38	0.31	0.21	0.16
21	$N_1P_1K_0$	0.22	0.21	0.18	0.14	0.29	0.21
22	$N_1P_1K_1$	0.21	0.37	0.25	0.16	0.31	0.16
23	$N_1P_1K_2$	0.23	0.26	0.21	0.19	0.23	0.08
24	$N_1P_1K_3$	0.21	0.29	0.48	0.20	0.34	0.17
25	$N_1P_2K_0$	0.24	0.37	0.39	0.22	0.35	0.23
26	$N_1P_2K_1$	0.29	0.22	0.19	0.18	0.33	0.25
27	$N_1P_2K_2$	0.36	0.24	0.30	0.31	0.55	0.23
28	$N_1P_2K_3$	0.25	0.25	0.33	0.35	0.45	0.28
29	$N_1P_3K_0$	0.19	0.26	0.17	0.19	0.33	0.25
30	$N_1P_3K_1$	0.18	0.24	0.17	0.14	0.28	0.37

Contd. Appendix XVI.

SL	Treatment	Site-1		Site-2		Site-3	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
31	$N_1P_3K_2$	0.33	0.27	0.16	0.23	0.49	0.29
32	$N_1P_3K_3$	0.30	0.28	0.32	0.28	0.30	0.24
33	$N_2P_0K_0$	0.23	0.25	0.32	0.21	0.39	0.24
34	$N_2P_0K_1$	0.27	0.25	0.24	0.19	0.25	0.20
35	$N_2P_0K_2$	0.19	0.24	0.32	0.20	0.39	0.27
36	$N_2P_0K_3$	0.21	0.25	0.27	0.23	0.23	0.15
37	$N_2P_1K_0$	0.22	0.27	0.33	0.21	0.51	0.17
38	$N_2P_1K_1$	0.33	0.22	0.19	0.14	0.47	0.25
39	$N_2P_1K_2$	0.32	0.28	0.33	0.15	0.33	0.23
40	$N_2P_1K_3$	0.31	0.32	0.21	0.13	0.31	0.29
41	$N_2P_2K_0$	0.22	0.26	0.51	0.40	0.34	0.24
42	$N_2P_2K_1$	0.26	0.30	0.32	0.16	0.51	0.38
43	$N_2P_2K_2$	0.28	0.19	0.40	0.23	0.31	0.20
44	$N_2P_2K_3$	0.23	0.20	0.37	0.41	0.31	0.18
45	$N_2P_3K_0$	0.25	0.30	0.18	0.31	0.26	0.17
46	$N_2P_3K_1$	0.26	0.20	0.18	0.27	0.33	0.15
47	$N_2P_3K_2$	0.27	0.23	0.35	0.20	0.55	0.37
48	$N_2P_3K_3$	0.19	0.25	0.27	0.29	0.46	0.19
49	$N_3P_0K_0$	0.23	0.20	0.26	0.15	0.53	0.23
50	$N_3P_0K_1$	0.24	0.21	0.35	0.17	0.39	0.22
51	$N_3P_0K_2$	0.26	0.27	0.29	0.20	0.42	0.27
52	$N_3P_0K_3$	0.26	0.20	0.22	0.27	0.51	0..37
53	$N_3P_1K_0$	0.25	0.20	0.53	0.32	0.41	0.25
54	$N_3P_1K_1$	0.29	0.30	0.35	0.25	0.27	0.09
55	$N_3P_1K_2$	0.27	0.30	0.47	0.41	0.28	0.08
56	$N_3P_1K_3$	0.23	0.43	0.23	0.26	0.20	0.10
57	$N_3P_2K_0$	0.29	0.32	0.28	0.22	0.41	0.22
58	$N_3P_2K_1$	0.22	0.34	0.44	0.22	0.48	0.26
59	$N_3P_2K_2$	0.26	0.23	0.24	0.25	0.63	0.24
60	$N_3P_2K_3$	0.30	0.25	0.28	0.37	0.34	0.25
61	$N_3P_3K_0$	0.26	0.30	0.25	0.21	0.25	0.26
62	$N_3P_3K_1$	0.25	0.16	0.57	0.51	0.25	0.20
63	$N_3P_3K_2$	0.26	0.16	0.27	0.53	0.24	0.21
64	$N_3P_3K_3$	0.28	0.22	0.38	0.48	0.26	0.21
Mean ±		0.25	0.26	0.30	0.28	0.36	0.23
%CV		28	38	39	42	31	41

Appendix XVII. ANOVA for total N of site-1 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	2.492E-04	2	1.246E-04	1.409 ns
P	3.500E-04	3	1.167E-04	1.319 ns
K	3.376E-05	2	1.688E-05	0.191 ns
NxP	0.000	0	-	0
PxK	0.000	0	-	0
NxK	1.125E-04	1	28.125	1.272 ns
NxPxK	0.000	0	-	-
Error	1.150E-03	13	8-846E-05	-
Total	0.170	26	-	-

ns= not significant

Appendix XVIII. ANOVA for available P of site-1 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	66.432	2	33.216	2.937 ns
P	47.250	3	15.750	1.393 ns
K	3.135	2	1.568	0.139 ns
NxP	0.000	0	-	0
PxK	0.000	0	-	0
NxK	28.125	1	28.125	2.487 ns
NxPxK	0.000	0	-	-
Error	147.00	13	11..308	-
Total	8858.000	26	-	-

ns= not significant

Appendix. XIX. ANOVA for available K of site-1 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	1.797E-03	2	8.985E-04	1.129 ns
P	4.925E-03	3	1.642E-03	2.062 ns
K	1.021E-02	2	5.103E-03	6.409*
NxP	0.000	0	0	0
PxK	0.000	0	0	0
NxK	2.450E-03	1	2.450E-03	3.077 ns
NxPxK	0.000	0	0	0
Error	1.035E-02	13	7.962E-04	0
Total	0.694	26	-	0

*Significant at $P< 0.05$, ns = not significant

Appendix XX. ANOVA for available Ca of site-1 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	0.291	2	0.145	5.75*
P	1.150E-03	3	3.833E-04	0.02 ns
K	4.481E-02	2	2.241E-02	0.89 ns
NxP	0.000	0	0	-
PxK	0.000	0	0	-
NxK	5.445E-02	1	5.445E-02	2.16 ns
NxPxK	0.000	0	-	-
Error	0.328	13	2.526E-02	-
Total	93. 663	26	-	-

*Significant at P< 0.05, ns = not significant

Appendix XXI. ANOVA for available Mg of site-1 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	1.713E-03	2	8.564E-04	0.569 ns
P	1.125E-02	3	3.750E-03	2.494 ns
K	3.615E-03	2	1.807E-03	1.202 ns
NxP	0.000	0	-	-
PxK	0.000	0	-	-
NxK	1.513E-03	1	1.513E-03	1.006 ns
NxPxK	0.000	0	-	-
Error	1.955E-02	13	1.504E-03	-
Total	1.776	26	-	-

ns = not significant

Appendix XXII. ANOVA for total N after 2 years of fertilizer application at Site-2

Sources of variation	Sum of squares	df	Mean squares	F- values
N	2.325E-03	3	7.750E-04	1.587 ns
P	7.531E-05	3	2.510E-05	0.051 ns
K	3.769E-03	3	1.256E-03	2.572 ns
NxP	0.000	0	-	-
PxK	0.000	0	-	-
NxK	0.000	0	-	-
NxPxK	6.350E-03	13	4.885E-04	-
Error	0.348	26		
Total				

ns = not significant

Appendix XXIII. ANOVA for available P of site-2 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	20.500	3	6.833	0.421 ns
P	40.382	3	13.461	0.829 ns
K	31.250	3	10.417	0.642 ns
NxP	0.000	0	-	-
PxK	0.000	0	-	-
NxK	0.000	0	-	-
NxPxK	0.000	0	-	-
Error	211.000	13	16.231	-
Total	10740.000	26	-	-

ns = not significant

Appendix XXIV. ANOVA for available K of site-2 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	6.675E-03	3	2.225E-03	1.008 ns
P	2.363E-03	3	7.878E-04	0.357 ns
K	9.219E-03	3	3.073E-03	1.392 ns
NxP	0.000	0	-	-
PxK	0.000	0	-	-
NxK	0.000	0	-	-
NxPxK	0.000	0	-	-
Error	2.870E-02	13	-	-
Total	0.917	26	-	-

ns = not significant

Appendix XXV. ANOVA for available Ca of site-2 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	1.211	3	0.404	2.826 ns
P	2.537	3	0.846	5.922**
K	0.212	3	7.067E-02	0.495 ns
NxP	0.000	0	-	-
PxK	0.000	0	-	-
NxK	0.000	0	-	-
NxPxK	0.000	0	-	-
Error	1.856	13	0.143	-
Total	111.046	26	-	-

** Significant at $P < 0.01$, ns = not significant.

Appendix XXVI. ANOVA for available Mg of site-2 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	5.850E-03	3	1.950E-03	0.643 ns
P	9.390E-03	3	3.130E-03	1.031 ns
K	6.269E-03	3	2.090E-03	0.689 ns
NxP	0.000	0	-	-
PxK	0.000	0	-	-
NxK	0.000	0	-	-
NxPxK	0.000	0	-	-
Error	3.945E-02	13	3.035E-03	-
Total	2.069	26	-	-

ns = not significant.

Appendix XXVII. ANOVA for total N of site-3 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	7.125E-04	2	3.562E-04	3.308 ns
P	0.000	1	0.000	0.000
K	1.000E-04	2	5.000E-05	0.464 ns
NxP	0.000	0	-	-
PxK	0.000	0	-	-
NxK	0.000	0	-	-
NxPxK	0.000	0	-	-
Error	1.400E-03	13	1.077E-04	-
Total	0.177	26	-	-

ns = not significant.

Appendix XXVIII. ANOVA for available P.of site-3 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	3.125	1.562	1.562	0.095 ns
P	0.000	0.000	0.000	0.000
K	6.250	3.125	3.125	0.191 ns
NxP	0.000	-	-	-
PxK	0.000	-	-	-
NxK	0.000	-	-	-
NxPxK	0.000	-	-	-
Error	213.00	16.385	-	-
Total	9194.00		-	-

ns = not significant.

Appendix XXIX. ANOVA for available K of site-3 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	1.103E-03	2	5.063E-04	0.294 ns
P	6.250E-04	2	6.250E-04	0.363 ns
K	4.000E-03	1	2.000E-03	1.161 ns
NxP	0.000	1	-	-
PxK	0.000	0	-	-
NxK	0.000	0	-	-
NxPxK	0.000	0	-	-
Error	2.240E-02	13	1.723E-03	-
Total	0.803	26	-	-

ns = not significant.

Appendix XXX. ANOVA for available Ca of site-3 after 2 years of fertilizer application.

Sources of variation	Sum of squares	df	Mean difference	F- values
N	2.664E-02	2	1.332E-02	0.274 ns
P	9.303E-02	1	9.303E-02	1.911 ns
K	0.250	22	0.125	2.5666 ns
NxP	0.000	0	-	-
PxK	0.000	0	-	-
NxK	0.000	0	-	-
NxPxK	0.000	0	-	-
Error	0.633	13	4.867E-02	
Total	81.462	26	-	

ns = not significant.

Appendix XXXI. ANOVA for available Mg of site-3 after 2 years of fertilizer application.

Sources of variation	Sum of squares	Df	Mean squares	F
N	5.400E-03	2	2.700E-03	1.100 ns
P	2.500E-05	1	2.500E-05	0.010 ns
K	3.425E-03	2	1.1712E-03	0.698 ns
NxP	0.000	0	-	-
PxK	0.000	0	-	-
NxK	0.000	0	-	-
NxPxK	0.000	0	-	-
Error	3.190E-02	13	2.454E-03	
Total	2.044	26		

ns = not significant.

Appendix XXXII. ANOVA for total N, and available P, K, Ca and Mg due to depth of soil of site-1 after 2 years of fertilizer application.

Parameter	Source of variation	Sum of squares	df	Mean squares	F
Total N	Treatment	1.885E-04	1	1.885E-04	2.649 ns
	Residual	1.708E-03	24	7.115E-05	
	Total	1.896E-03	25		
Available P	Treatment	104.000	1	104.000	9.680**
	Residual	257.846	24	10.744	
	Total	361.846	25		
Available K	Treatment	3.115E-04	1	3.115E-04	0.148 ns
	Residual	5.040E-02	24	2.100E-03	
	Total	5.071E-02	25		
Available Ca	Treatment	0.235	1	0.235	4.713*
	Residual	1.195	24	4.979E-02	
	Total	1.430	25		
Available Mg	Treatment	1.163E-02	1	1.163E-02	8.573**
	Residual	3.257E-02	24	1.357E-03	
	Total	4.420E-02	25		

* Significant at $P<0.05$, ** significant at $P< 0.01$, ns = not significant.

Appendix XXXIII. ANOVA for total N, and available P, K, Ca and Mg due to depth of soil of site-2 after 2 years of fertilizer application.

Parameter	Source of variation	Sum of squares	df	Mean squares	F
Total N	Treatment	2.035E-03	1	2.035E-03	4.378*
	Residual	1.115E-02	24	4.647E-04	
	Total	1.319E-02	25		
Available P	Treatment	157.538	1	157.538	14.414***
	Residual	262.308	24	10.929	
	Total	419.846	25		
Available K	Treatment	2.106E-02	1	2.106E-02	16.098***
	Residual	3.140E-02	24	1.308E-03	
	Total	5.246E-02	25		
Available Ca	Treatment	0.860	1	0.860	1.924 ns
	Residual	10.735	24	0.447	
	Total	11.595	25		
Available Mg	Treatment	1.885E-04	1	1.250E-02	3.341 ns
	Residual	1.708E-03	24	3.740E-03	
	Total	1.896E-03	25		

* Significant at $P<0.05$, *** significant at $P< 0.001$, ns = not significant.

Appendix XXXIV. ANOVA for total N, and available P, K, Ca and Mg due to depth of soil of site-3 after 2 years of fertilizer application.

Parameter	Source of variation	Sum of squares	df	Mean squares	F
Total N	Treatment	2.462E-04	1	2.462E-04	1.444 ns
	Residual	4.092E-03	24	1.705E-04	
	Total	4.338E-03	25		
Available P	Treatment	177.846	1	177.846	18.695***
	Residual	228.308	24	9.513	
	Total	406.154	25		
Available K	Treatment	5.554E-03	1	5.554E-03	5.185*
	Residual	2.571E-02	24	1.071E-03	
	Total	3.126E-02	25		
Available Ca	Treatment	6.302E-02	1	6.302E-02	0.448 ns
	Residual	3.376	24	0.141	
	Total	3.439	25		
Available Mg	Treatment	2.340E-02	1	2.340E-02	20.991***
	Residual	2.675E-02	24	1.115E-03	
	Total	5.015E-02	25		

* Significant at $P<0.05$, *** significant at $P< 0.001$ ns = not significant.

Appendix XXXV. ANOVA for leaf nutrients of rubber in site-1 in Dec, '94 and Sept. '95.

Parameter	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
N in Dec, 94	Treatment	2.174	12	.181	3.84**	.002
	Error	1.228	26	4.722E-02		
	Total	3.402	38			
N in Sept, 95	Treatment	1.172	12	9.766E-02	1.51ns	.183
	Error	1.681	26	6.467E-02		
	Total	2.853	38			
P in Dec, 94	Treatment	1.970E-02	12	1.642E-03	1.40ns	.229
	Error	3.053E-02	26	1.174E-03		
	Total	5.024E-02	38			
P in Sept, 95	Treatment	2.844E-02	12	2.370E-03	1.86ns	.091
	Error	3.320E-02	26	1.277E-03		
	Total	6.164E-02	38			
K in Dec, 94	Treatment	.848	12	7.065E-02	1.34ns	.256
	Error	1.371	26	5.274E-02		
	Total	2.219	38			
PK in Sept, 95	Treatment	.510	12	4.248E-02	.738	.704
	Error	1.497	26	5.759E-02		
	Total	2.007	38			
Ca in Dec, 94	Treatment	.938	12	7.815E-02	0.92ns	.545
	Error	2.217	26	8.527E-02		
	Total	3.155	38			
Ca in Sept, 95	Treatment	.232	12	1.930E-02	0.78ns	.664
	Error	.642	26	2.468E-02		
	Total	.873	38			
Mg in Dec, 94	Treatment	7.510E-02	12	6.255E-03	0.59ns	.829
	Error	.275	26	1.056E-02		
	Total	.350	38			
Mg in Sept, 95	Treatment	5.697E-02	12	4.748E-03	0.49ns	.897
	Error	.248	26	9.544E-03		
	Total	.305	38			

*Significant at 5%, ** significant at 1%, *** significant at 0.1% level, ns = not significant

Appendix XXXVI. ANOVA for leaf nutrients of rubber in site-1 in Dec, '95 and Sept. '96.

Parameter	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
N in Dec, 95	Treatment	2.239	12	.187	0.67ns	.766
	Error	7.276	26	.280		
	Total	9.515	38			
Nin Sept, 96	Treatment	.752	12	6.269E-02	1.12ns	.388
	Error	1.458	26	5.606E-02		
	Total	2.210	38			
P in Dec, 95	Treatment	3.312E-02	12	2.760E-03	3.93**	.002
	Error	1.827E-02	26	7.026E-04		
	Total	5.139E-02	38			
P in Sep, 96	Treatment	4.837E-02	12	4.031E-03	3.47**	.004
	Error	3.020E-02	26	1.162E-03		
	Total	7.857E-02	38			
K in Dec, 95	Treatment	.264	12	2.202E-02	0.72ns	.721
	Error	.796	26	3.063E-02		
	Total	1.061	38			
K in Sept, 96	Treatment	.224	12	1.864E-02	0.84ns	.610
	Error	.576	26	2.216E-02		
	Total	.800	38			
Ca in Dec, 95	Treatment	.425	12	3.539E-02	0.36ns	.965
	Error	2.526	26	9.714E-02		
	Total	2.950	38			
CAS1SE96	Treatment	.498	12	4.150E-02	1.08ns	.416
	Error	1.000	26	3.848E-02		
	Total	1.498	38			
Mg in Dec, 95	Treatment	3.663E-02	12	3.053E-03	1.479	.195
	Error	5.367E-02	26	2.064E-03		
	Total	9.030E-02	38			
M in Sept, 96	Treatment	.101	12	8.433E-03	1.61ns	.150
	Error	.136	26	5.241E-03		
	Total	.237	38			

*Significant at 5%, ** significant at 1%, *** significant at 0.1% level, ns = not significant

Appendix XXXVII. ANOVA for leaf nutrients of rubber in site-2 in Dec, '94 and Sept. '95.

Parameter	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
N in Dec, 94	Treatment	.767	12	6.391E-02	7.30***	.000
	Error	.227	26	8.749E-03		
	Total	.994	38			
N in Sept, 95	Treatment	.849	12	7.074E-02	3.66**	.003
	Error	.502	26	1.932E-02		
	Total	1.351	38			
P in Dec, 94	Treatment	7.303E-03	12	6.085E-04	0.68ns	.751
	Error	2.313E-02	26	8.897E-04		
	Total	3.044E-02	38			
P in Sept, 95	Treatment	3.156E-02	12	2.630E-03	3.33**	.005
	Error	2.053E-02	26	7.897E-04		
	Total	5.210E-02	38			
K in Dec, 94	Treatment	.601	12	5.009E-02	5.04***	.000
	Error	.258	26	9.933E-03		
	Total	.859	38			
K in Sept, 95	Treatment	.738	12	6.153E-02	4.77***	.000
	Error	.335	26	1.289E-02		
	Total	1.074	38			
Ca in Dec, 94	Treatment	.739	12	6.157E-02	0.64ns	.787
	Error	2.490	26	9.575E-02		
	Total	3.228	38			
Ca in Sept, 95	Treatment	.853	12	7.111E-02	2.49*	.025
	Error	.743	26	2.859E-02		
	Total	1.597	38			
Mg in Dec, 94	Treatment	.156	12	1.299E-02	0.81ns	.640
	Error	.418	26	1.608E-02		
	Total	.574	38			
Mg in Sept, 95	Treatment	.105	12	8.787E-03	1.35ns	.252
	Error	.162	25	6.491E-03		
	Total	.268	37			

*Significant at 5%, ** significant at 1%, *** significant at 0.1% level, ns = not significant

Appendix XXXVIII. ANOVA for leaf nutrients of rubber in site-2 in Dec, '95 and Sept. '96.

Parameter	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
N in Dec '95	Treatment	.458	12	3.816E-02	5.36***	.000
	Error	.185	26	7.115E-03		
	Total	.643	38			
N in Sept '96	Treatment	.770	12	6.414E-02	11.49***	.000
	Error	.145	26	5.582E-03		
	Total	.915	38			
P in Dec '95	Treatment	1.433E-02	12	1.194E-03	1.35ns	.259
	Error	2.327E-02	26	8.949E-04		
	Total	3.760E-02	38			
P in Sept '96	Treatment	1.063E-02	12	8.855E-04	0.79ns	.656
	Error	2.913E-02	26	1.121E-03		
	Total	3.976E-02	38			
K in Dec '95	Treatment	.434	12	3.614E-02	1.65ns	.138
	Error	.570	26	2.191E-02		
	Total	1.003	38			
KS2SEP96	Treatment	.252	12	2.103E-02	8.50***	.000
	Error	6.433E-02	26	2.474E-03		
	Total	.317	38			
Ca in Dec '95	Treatment	.343	12	2.862E-02	4.26***	.001
	Error	.175	26	6.715E-03		
	Total	.518	38			
Ca in Sept '96	Treatment	.113	12	9.392E-03	1.05ns	.438
	Error	.233	26	8.954E-03		
	Total	.346	38			
Mg in Dec '95	Treatment	8.489E-02	12	7.074E-03	3.62**	.003
	Error	5.087E-02	26	1.956E-03		
	Total	.136	38			
Mg in Sept '96	Treatment	.159	12	1.323E-02	2.10ns	.055
	Error	.164	26	6.290E-03		
	Total	.322	38			

*Significant at 5%, ** significant at 1%, *** significant at 0.1% level, ns = not significant

Appendix XXXIX. ANOVA for leaf nutrients of rubber in site-3 in Dec, '94 and Sept. '95.

Parameter	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
N in Dec '94	Treatment	1.083	12	9.029E-02	1.29ns	.280
	Error	1.816	26	6.983E-02		
	Total	2.899	38			
N in Sept '95	Treatment	1.109	12	9.241E-02	1.62ns	.148
	Error	1.487	26	5.720E-02		
	Total	2.596	38			
P in Dec '94	Treatment	1.428E-02	12	1.190E-03	1.91ns	.081
	Error	1.620E-02	26	6.231E-04		
	Total	3.048E-02	38			
P in Sept '95	Treatment	4.791E-02	12	3.992E-03	4.21***	.001
	Error	2.467E-02	26	9.487E-04		
	Total	7.257E-02	38			
K in Dec '94	Treatment	.883	12	7.358E-02	9.69***	.000
	Error	.197	26	7.595E-03		
	Total	1.080	38			
K in Sept '95	Treatment	.873	12	7.276E-02	4.99***	.000
	Error	.379	26	1.459E-02		
	Total	1.252	38			
Ca in Dec '94	Treatment	.396	12	3.301E-02	1.50ns	.185
	Error	.570	26	2.194E-02		
	Total	.967	38			
Ca in Sept '95	Treatment	.535	12	4.459E-02	2.01ns	.067
	Error	.578	26	2.222E-02		
	Total	1.113	38			
Mg in Dec '94	Treatment	8.544E-02	12	7.120E-03	1.19ns	.367
	Error	.161	26	6.197E-03		
	Total	.247	38			
Mg in Sept '95	Treatment	.102	12	8.514E-03	2.55*	.022
	Error	8.673E-02	26	3.336E-03		
	Total	.189	38			

*Significant at 5%, ** significant at 1%, *** significant at 0.1% level, ns = not significant

Appendix XI.. ANOVA for leaf nutrients of rubber in site-3 in Dec, '95 and Sept. '96.

Parameter	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
N in Dec '95	Treatment	.567	12	4.721E-02	4.03***	.001
	Error	.304	26	1.171E-02		
	Total	.871	38			
N in Sept '96	Treatment	.725	12	6.041E-02	2.54*	.023
	Error	.619	26	2.379E-02		
	Total	1.343	38			
P in Dec '95	Treatment	1.469E-02	12	1.224E-03	1.87ns	.088
	Error	1.700E-02	26	6.538E-04		
	Total	3.169E-02	38			
P in Sept '96	Treatment	5.643E-02	12	4.702E-03	8.91***	.000
	Error	1.367E-02	26	5.256E-04		
	Total	7.009E-02	38			
K in Dec '95	Treatment	.775	12	6.460E-02	3.56**	.003
	Error	.472	26	1.815E-02		
	Total	1.247	38			
K in Sept '96	Treatment	.868	12	7.236E-02	8.31***	.000
	Error	.226	26	8.703E-03		
	Total	1.095	38			
Ca in Dec '95	Treatment	.396	12	3.301E-02	5.66***	.000
	Error	.152	26	5.833E-03		
	Total	.548	38			
Ca in Sept '96	Treatment	.274	12	2.281E-02	3.32**	.005
	Error	.179	26	6.877E-03		
	Total	.453	38			
Mg in Dec '95	Treatment	.186	12	1.554E-02	6.08**	.000
	Error	6.640E-02	26	2.554E-03		
	Total	.253	38			
Mg in Sept '96	Treatment	7.537E-02	12	6.281E-03	2.75*	.015
	Error	5.947E-02	26	2.287E-03		
	Total	.135	38			

* Significant at 5%, ** significant at 1%, *** significant at 0.1% level, ns = not significant

Appendix XLI. Paired sample t-test for leaf nutrients of rubber between December '94 and September '95 in site-1.

Pair	Paired differences		df	t-value
	Mean	Std. Error of mean		
N Dec. 94 – Sept. 95	-0.5687	6.842E-02	38	-8.312***
P Dec. 94 – Sept. 95	-2.9231E-02	6.173E-03	38	-4.7350***
K Dec. 94 – Sept. 95	-0.2477	5.049E-02	38	-4.9061***
Ca Dec. 94 – Sept. 95	0.2808	4.963E-02	38	5.6567***
Mg Dec. 94 – Sept. 95	-3.7949E-02	2.245E-02	38	-1.6905 ns

*** significant at P< 0.001 ns = not significant.

Appendix XLII. Paired sample t-test for leaf nutrients of rubber between December '95 and September '96 in site-1.

Pair	Paired differences		df	t-value
	Mean	Std. Error of mean		
N Dec. 95 – Sept. 96	-5.1282E-02	7.826E-02	38	-0.655 ns
P Dec. 95 – Sept. 96	-3.5897E-02	4.086E-03	38	-8.785***
K Dec. 95 – Sept. 96	-0.1208	8.001E-03	38	-15.093***
Ca Dec. 95 – Sept. 96	0.2303	4.685E-02	38	4.915***
Mg Dec. 95 – Sept. 96	-2.6923E-02	1.379E-02	38	-1.953 ns

*** significant at P< 0.001, ns = not significant.

Appendix XLIII. Paired sample t-test for leaf nutrients of rubber between December '94 and September '95 in site-2.

Pair	Paired differences		df	t-value
	Mean	Std. Error of mean		
N Dec. 94 – Sept. 95	-0.1721	3.785E-02	38	-4.546***
P Dec. 94 – Sept. 95	-2.8974E-02	6.487E-03	38	-4.467***
K Dec. 94 – Sept. 95	0.1831	3.620E-02	38	5.058***
Ca Dec. 94 – Sept. 95	0.2987	5.569E-02	38	5.363***
Mg Dec. 94 – Sept. 95	8.846E-02	1.066E-02	38	8.296***

*** significant at P< 0.001.

Appendix XLIV. Paired sample t-test for leaf nutrients of rubber between December '95 and September '96 in site-2.

Pair	Paired differences		df	t-value
	Mean	Std. Error of mean		
N Dec. 95 – Sept. 96	-0.1828	1.950E-02	38	-9.373***
P Dec. 95 – Sept. 96	-2.8974E-02	4.556E-03	38	-6.360***
K Dec. 95 – Sept. 96	8.154E-02	2.804E-02	38	2.908***
Ca Dec. 95 – Sept. 96	0.2015	1.987E-02	38	10.143***
Mg Dec. 95 – Sept. 96	5.513E-02	1.559E-02	38	3.537***

*** significant at P< 0.001.

Appendix XLV. Paired sample t-test for leaf nutrients of rubber between December '94 and September '95 in site-3.

Pair	Paired differences		df	t-value
	Mean	Std. Error of mean		
N Dec. 94 – Sept. 95	-0.2423	5.839E-02	38	-4.1***
P Dec. 94 – Sept. 95	-1.1026E-02	8.204E-03	38	-1.34 ns
K Dec. 94 – Sept. 95	8.769E-02	3.474E-02	38	2.524*
Ca Dec. 94 – Sept. 95	0.1549	2.571E-02	38	6.024***
Mg Dec. 94 – Sept. 95	-2.4359E-02	1.528E-02	38	-1.59 ns

*** significant at P< 0.001, ns = not significant.

Appendix XLVI. Paired sample t-test for leaf nutrients of rubber between December '95 and September '96 in site-3.

Pair	Paired differences		df	t-value
	Mean	Std. Error of mean		
N Dec. 95 – Sept. 96	-0.1944	4.128E-02	38	-4.708***
P Dec. 95 – Sept. 96	-3.000E-02	7.133E-03	38	-4.206***
K Dec. 95 – Sept. 96	2.282E-02	4.204E-02	38	0.543 ns
Ca Dec. 95 – Sept. 96	0.1613	2.422E-02	38	6.659***
Mg Dec. 95 – Sept. 96	-2.7949E-02	1.228E-02	38	-2.276***

*** significant at P< 0.001, ns = not significant.

Appendix XLVII. Monthly production of latex (cc/tree/tap) in block-1 of site-1 during October 1994 to September 1995.

SL	Treatment	1994			1995									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	60.00	75.00	65.00	57.50	43.75	43.30	45.00	43.75	53.75	50.00	35.00	75.00	53.92
2	$N_0P_0K_1$	75.00	93.30	50.30	37.50	50.00	35.64	48.00	46.67	43.33	62.50	35.00	65.00	53.52
3	$N_0P_0K_2$	65.00	62.50	33.30	37.50	50.00	75.00	50.00	33.33	43.33	50.00	33.33	51.04	48.69
4	$N_0P_0K_3$	55.00	80.00	60.00	40.00	25.00	22.50	40.00	26.67	36.67	50.00	25.00	48.54	42.45
5	$N_0P_1K_0$	90.00	80.00	50.00	50.00	37.50	31.30	46.66	42.50	43.75	50.00	57.50	70.00	54.10
6	$N_0P_1K_1$	91.00	75.00	100.00	43.80	25.00	46.70	55.00	52.75	80.00	77.50	82.75	75.00	67.04
7	$N_0P_1K_2$	75.00	85.00	70.00	57.50	49.04	52.00	49.20	55.50	63.89	63.00	70.00	76.50	63.89
8	$N_0P_1K_3$	80.00	70.00	50.00	50.00	33.30	41.70	50.00	26.67	83.33	66.67	50.00	75.00	56.39
9	$N_0P_2K_0$	70.00	60.00	55.00	50.00	45.92	51.00	56.00	61.00	57.00	65.00	71.00	98.00	61.66
10	$N_0P_2K_1$	77.00	70.00	50.00	40.00	32.50	45.00	50.00	55.00	65.00	68.00	72.50	95.00	60.00
11	$N_0P_2K_2$	70.00	61.70	57.00	50.00	35.00	37.00	42.50	44.75	48.33	55.00	50.00	60.00	50.94
12	$N_0P_2K_3$	63.00	75.00	50.00	40.00	45.00	40.00	46.66	46.00	61.64	68.75	75.00	95.00	58.84
13	$N_0P_3K_0$	100.00	90.00	75.00	61.00	55.00	57.00	69.00	58.00	47.50	48.67	45.50	60.95	63.97
14	$N_0P_3K_1$	70.00	68.00	60.00	55.00	31.30	50.00	34.25	52.00	65.00	56.50	76.67	87.50	58.85
15	$N_0P_3K_2$	84.00	65.00	60.00	56.00	50.00	43.00	46.00	60.00	90.00	83.33	91.59	86.60	67.96
16	$N_0P_3K_3$	70.48	95.00	85.00	45.00	40.00	43.00	50.00	55.00	58.00	58.33	59.04	66.67	60.46
17	$N_1P_0K_0$	88.80	86.70	80.00	50.00	62.50	35.00	37.50	47.50	48.75	80.00	58.00	68.19	61.91
18	$N_1P_0K_1$	73.80	60.00	63.30	60.00	50.00	33.30	20.00	36.67	31.25	50.00	42.50	58.54	48.28
19	$N_1P_0K_2$	85.00	90.00	40.00	37.50	35.00	45.00	50.00	40.00	46.67	70.00	65.00	73.13	56.44
20	$N_1P_0K_3$	92.00	90.00	80.00	40.00	45.00	45.00	50.00	54.00	57.50	66.52	75.00	94.00	65.71
21	$N_1P_1K_0$	85.00	70.50	60.00	62.00	47.50	55.00	42.50	62.50	60.00	68.75	65.00	75.00	62.81
22	$N_1P_1K_1$	105.00	70.00	58.00	42.00	33.30	45.50	50.00	63.50	65.50	70.00	87.50	100.00	65.86
23	$N_1P_1K_2$	70.00	60.00	50.00	60.00	43.80	40.00	47.50	30.00	31.25	35.00	37.50	66.67	47.64
24	$N_1P_1K_3$	70.00	62.50	53.80	47.50	50.00	40.00	42.00	55.00	50.00	60.00	50.00	63.33	53.68
25	$N_1P_2K_0$	85.00	70.00	58.00	55.50	57.50	65.00	62.00	63.30	60.50	60.00	65.00	76.40	64.85
26	$N_1P_2K_1$	79.00	65.00	52.00	40.00	30.50	40.50	37.50	60.00	68.75	89.64	75.00	100.00	61.49
27	$N_1P_2K_2$	90.00	65.00	64.00	60.00	30.00	44.00	53.75	55.00	60.00	76.00	83.00	90.48	64.27
28	$N_1P_2K_3$	105.84	90.00	60.00	60.00	40.00	47.00	52.25	75.00	60.00	130.00	106.25	100.00	77.20
29	$N_1P_3K_0$	62.00	62.50	30.00	40.00	33.30	37.50	30.50	33.33	30.00	50.00	36.67	45.00	40.90
30	$N_1P_3K_1$	65.00	50.00	45.00	32.50	50.00	45.00	32.50	30.00	43.33	60.00	45.00	66.67	47.08
31	$N_1P_3K_2$	85.00	78.00	70.00	50.00	46.70	50.00	57.50	42.00	47.00	50.00	68.75	70.00	59.58
32	$N_1P_3K_3$	75.00	85.00	40.00	25.12	45.00	48.00	39.50	45.00	36.67	49.92	33.25	70.50	49.41
33	$N_2P_0K_0$	55.00	70.00	44.00	40.00	45.00	18.80	35.00	30.00	50.00	56.25	37.50	55.00	44.71

(Contd. Appendix XLVII)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	90.00	93.30	53.30	43.30	37.50	50.00	55.00	45.00	65.00	60.00	70.00	87.50	62.49
35	$N_2P_0K_2$	80.00	82.42	75.00	62.50	56.25	50.00	35.00	36.00	40.67	50.00	66.67	73.33	58.99
36	$N_2P_0K_3$	70.00	88.30	83.30	62.50	20.00	28.70	33.30	35.00	56.67	63.33	48.75	75.00	55.40
37	$N_2P_1K_0$	53.80	56.70	58.30	58.00	25.30	25.00	47.50	30.00	40.00	55.00	42.50	66.67	46.56
38	$N_2P_1K_1$	79.00	81.00	76.00	64.00	56.70	51.00	54.00	50.00	55.00	65.00	56.00	87.50	64.60
39	$N_2P_1K_2$	65.00	58.00	37.50	35.00	25.00	31.70	30.33	40.00	50.00	48.33	35.00	50.00	42.16
40	$N_2P_1K_3$	78.00	68.80	60.00	52.00	40.00	37.50	35.00	33.33	40.00	36.25	36.67	50.00	47.30
41	$N_2P_2K_0$	47.50	35.00	36.70	26.96	25.00	31.00	35.30	40.97	50.00	56.25	55.00	62.40	41.84
42	$N_2P_2K_1$	55.00	75.00	50.00	33.30	33.30	23.84	25.00	36.67	38.33	36.67	41.67	37.50	40.52
43	$N_2P_2K_2$	90.00	65.00	50.00	40.00	41.00	30.00	30.00	37.50	46.25	53.33	40.00	56.60	48.31
44	$N_2P_2K_3$	58.00	52.00	50.00	35.00	33.30	32.00	40.00	43.33	35.00	40.00	55.00	65.00	44.89
45	$N_2P_3K_0$	92.00	70.00	62.50	50.00	63.30	55.00	47.50	42.50	50.00	55.00	53.33	75.00	59.68
46	$N_2P_3K_1$	100.00	79.50	75.50	50.00	45.00	40.00	42.50	28.00	50.00	62.50	43.33	60.00	56.36
47	$N_2P_3K_2$	92.26	95.00	71.70	40.00	34.64	28.30	40.00	45.00	47.50	90.00	80.00	77.50	61.83
48	$N_2P_3K_3$	115.04	80.00	75.00	45.00	50.00	63.30	47.50	34.00	43.33	60.00	55.00	75.00	61.93
49	$N_3P_0K_0$	60.00	75.00	40.00	40.00	36.90	20.00	25.00	17.50	31.25	50.00	43.33	52.50	40.96
50	$N_3P_0K_1$	58.80	52.50	37.50	38.50	44.00	33.30	21.70	26.67	45.00	50.00	45.00	57.50	42.54
51	$N_3P_0K_2$	70.00	90.00	66.70	62.50	50.00	35.00	45.00	43.33	53.33	60.00	45.00	53.33	56.18
52	$N_3P_0K_3$	100.00	90.00	60.00	40.00	26.70	37.50	50.00	36.67	50.00	60.00	77.50	83.33	59.31
53	$N_3P_1K_0$	81.00	79.00	60.00	56.70	59.06	38.84	28.75	31.25	50.00	55.00	51.00	49.00	53.30
54	$N_3P_1K_1$	87.50	75.00	66.70	50.00	56.70	40.00	33.33	25.00	55.00	65.00	45.00	40.00	53.27
55	$N_3P_1K_2$	95.00	60.00	40.00	58.30	50.00	41.70	36.66	25.00	33.33	44.00	62.50	100.00	53.87
56	$N_3P_1K_3$	82.50	87.50	80.00	50.00	45.00	64.00	63.75	81.25	65.00	75.00	70.00	73.31	69.78
57	$N_3P_2K_0$	40.00	45.00	40.00	27.50	24.00	20.00	34.00	35.25	23.00	25.00	34.79	45.00	32.80
58	$N_3P_2K_1$	100.00	71.70	65.00	58.00	69.00	56.00	56.70	63.00	60.00	62.00	61.80	80.33	66.96
59	$N_3P_2K_2$	100.00	86.96	81.30	60.50	55.00	48.50	58.00	56.67	57.25	65.00	67.50	87.50	68.68
60	$N_3P_2K_3$	56.00	54.00	37.50	37.50	40.00	22.50	43.30	28.75	50.00	45.00	53.00	49.00	43.05
61	$N_3P_3K_0$	75.00	87.50	65.00	50.00	37.50	35.00	45.00	65.00	75.00	82.50	80.00	100.00	66.46
62	$N_3P_3K_1$	55.00	50.00	50.00	33.30	30.00	33.00	40.00	41.00	60.25	49.96	70.00	75.00	48.96
63	$N_3P_3K_2$	66.70	75.00	35.00	40.00	30.00	25.00	40.00	22.50	35.00	46.67	35.00	50.00	41.74
64	$N_3P_3K_3$	50.00	41.70	37.50	38.50	45.25	30.00	35.00	25.00	40.00	48.75	53.33	65.00	42.50
	Mean	76.72	72.37	57.59	47.22	41.88	40.73	43.76	43.49	51.23	59.76	56.79	70.60	55.12
	%CV	21.24	19.64	26.19	22.15	26.59	28.88	24.87	31.49	25.79	26.43	30.52	23.64	17.07

Appendix XLVIII. Monthly production of latex (cc/tree/tap) in block-2 of site-1 during October 1994 to September 1995.

SL	Treatment	1994			1995									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	72.00	70.50	65.00	50.00	50.00	52.50	45.00	47.50	50.00	55.00	58.33	60.00	56.32
2	$N_0P_0K_1$	90.00	95.00	80.00	90.00	50.00	65.00	50.00	53.00	46.00	50.00	45.00	50.00	63.67
3	$N_0P_0K_2$	75.00	50.00	40.00	50.00	30.00	40.00	37.50	35.00	56.25	50.00	55.00	68.75	48.96
4	$N_0P_0K_3$	81.00	99.00	80.00	40.00	30.00	53.00	50.00	51.00	45.00	46.58	50.00	63.75	57.44
5	$N_0P_1K_0$	55.00	65.00	40.00	26.70	30.00	35.00	30.00	36.00	47.50	46.00	47.00	48.50	42.23
6	$N_0P_1K_1$	70.00	87.00	54.00	48.00	43.80	38.00	30.50	47.00	48.00	50.92	57.50	53.30	52.34
7	$N_0P_1K_2$	130.00	91.30	90.72	67.00	64.80	73.30	67.50	77.50	75.00	85.00	97.50	95.00	84.55
8	$N_0P_1K_3$	88.00	85.00	60.00	56.00	40.00	52.00	48.00	44.00	54.00	66.67	71.00	75.00	61.64
9	$N_0P_2K_0$	70.00	64.00	59.00	58.50	56.00	52.00	53.00	51.67	55.24	62.50	70.50	71.00	60.28
10	$N_0P_2K_1$	82.50	76.30	63.30	65.00	55.00	45.00	50.00	45.00	54.33	80.00	85.00	84.00	65.45
11	$N_0P_2K_2$	65.00	72.00	58.00	50.00	40.00	45.00	40.00	40.00	38.00	40.00	38.25	49.75	48.00
12	$N_0P_2K_3$	71.35	73.00	61.00	51.60	50.00	52.00	56.66	56.67	68.33	70.00	73.33	70.00	62.50
13	$N_0P_3K_0$	70.00	56.54	50.00	37.50	33.30	35.00	47.50	60.00	55.00	70.00	68.33	70.00	54.43
14	$N_0P_3K_1$	50.00	93.00	83.38	60.00	50.00	28.80	35.00	40.00	66.67	75.00	51.00	56.00	57.40
15	$N_0P_3K_2$	95.00	60.00	73.30	60.00	58.30	30.00	50.00	43.75	50.00	55.00	76.67	81.67	61.14
16	$N_0P_3K_3$	70.00	80.00	52.30	53.00	51.00	59.04	51.00	55.00	53.75	60.00	91.67	100.00	64.73
17	$N_1P_0K_0$	98.00	86.70	72.00	60.00	48.00	42.50	65.00	70.00	75.00	100.00	85.81	93.75	74.73
18	$N_1P_0K_1$	68.80	85.00	72.00	55.00	51.00	49.00	31.25	33.00	50.00	45.00	47.50	58.75	53.86
19	$N_1P_0K_2$	72.50	98.30	62.50	50.00	40.00	60.00	65.00	57.50	56.25	68.00	70.00	63.27	63.61
20	$N_1P_0K_3$	65.00	50.00	40.00	42.00	40.00	35.00	45.00	45.00	47.54	50.00	56.00	54.00	47.46
21	$N_1P_1K_0$	107.00	115.00	70.00	60.00	55.00	58.00	65.00	57.00	63.33	94.67	78.00	100.00	76.92
22	$N_1P_1K_1$	101.00	90.00	65.00	59.00	50.00	62.50	65.00	77.50	63.33	80.00	75.00	70.00	71.53
23	$N_1P_1K_2$	62.50	50.00	40.00	45.00	30.00	35.00	41.66	36.67	52.00	55.00	53.00	52.00	46.07
24	$N_1P_1K_3$	72.50	75.00	70.14	65.00	56.70	52.50	56.25	60.00	62.38	65.00	58.33	60.00	62.82
25	$N_1P_2K_0$	65.00	67.50	59.92	46.70	30.00	32.50	45.00	55.00	57.00	63.33	63.00	60.00	53.75
26	$N_1P_2K_1$	90.00	95.00	60.00	65.00	55.50	58.00	52.00	49.00	51.00	64.16	72.50	98.50	67.56
27	$N_1P_2K_2$	105.00	81.00	66.00	50.00	37.50	48.38	46.66	45.00	50.00	62.50	59.00	60.00	59.25
28	$N_1P_2K_3$	99.00	67.48	55.00	39.30	30.00	33.30	60.00	58.38	55.00	58.00	75.00	90.00	60.04
29	$N_1P_3K_0$	65.00	75.00	80.00	50.00	33.30	37.00	45.00	56.00	50.75	60.00	65.50	84.50	58.50
30	$N_1P_3K_1$	100.00	83.30	60.00	40.00	50.00	43.30	48.33	50.00	58.00	62.00	83.33	80.00	63.19
31	$N_1P_3K_2$	61.00	68.80	60.00	50.00	46.70	45.00	55.00	70.67	71.67	64.46	75.50	87.50	63.03
32	$N_1P_3K_3$	60.00	63.80	62.50	57.50	50.00	45.00	41.25	45.00	60.00	80.00	92.50	125.00	65.21
33	$N_2P_0K_0$	110.00	105.00	65.00	50.00	40.00	41.00	49.00	25.00	54.00	45.00	35.00	50.00	55.75

(Contd. Appendix XLVIII.)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	85.00	80.00	60.00	40.00	49.00	45.00	46.00	47.00	45.00	50.00	56.00	64.00	55.58
35	$N_2P_0K_2$	91.00	100.00	70.00	60.00	55.00	68.00	70.00	68.00	67.50	70.00	80.00	103.94	75.29
36	$N_2P_0K_3$	60.00	55.00	45.00	33.30	30.00	45.00	35.00	37.46	54.00	50.00	52.50	46.00	45.27
37	$N_2P_1K_0$	60.00	48.66	45.00	44.00	31.00	30.00	40.00	50.00	55.00	45.00	50.00	33.33	44.33
38	$N_2P_1K_1$	115.00	100.00	75.00	65.00	60.00	50.00	66.25	76.67	74.00	63.33	86.67	100.00	77.66
39	$N_2P_1K_2$	67.00	63.00	62.50	33.30	25.00	30.00	37.50	53.33	46.00	50.00	54.00	65.00	48.89
40	$N_2P_1K_3$	70.79	61.00	53.30	50.00	40.00	37.50	42.00	61.25	66.67	73.33	85.00	77.00	59.82
41	$N_2P_2K_0$	65.00	68.00	65.00	63.50	51.55	42.00	53.75	55.00	50.00	45.00	50.00	63.33	56.01
42	$N_2P_2K_1$	70.00	55.00	40.00	36.70	25.00	21.30	41.25	40.00	50.00	62.50	33.00	33.66	42.37
43	$N_2P_2K_2$	87.00	77.00	70.00	61.00	54.00	51.00	41.66	48.00	50.00	47.50	57.50	63.33	59.00
44	$N_2P_2K_3$	70.00	60.00	50.00	45.00	40.00	37.50	43.33	59.00	60.00	61.00	60.00	65.00	54.24
45	$N_2P_3K_0$	100.00	80.00	75.00	50.00	53.30	55.00	50.00	57.50	48.25	65.00	75.00	99.96	67.42
46	$N_2P_3K_1$	120.00	85.00	80.00	50.00	65.00	70.00	73.75	55.00	67.50	70.00	75.00	112.50	76.98
47	$N_2P_3K_2$	66.00	67.50	50.00	40.00	45.00	44.00	40.00	45.00	50.67	47.50	55.00	65.00	51.31
48	$N_2P_3K_3$	40.00	48.00	50.00	51.00	49.00	41.00	31.25	31.00	43.50	48.00	54.00	58.00	45.40
49	$N_3P_0K_0$	40.00	50.00	40.00	37.50	36.30	43.80	45.00	33.66	38.00	50.00	51.71	60.00	43.83
50	$N_3P_0K_1$	75.00	73.00	52.00	38.00	35.36	45.00	34.92	48.00	33.37	45.00	57.50	60.00	49.76
51	$N_3P_0K_2$	50.00	65.00	43.72	35.00	30.00	35.00	30.00	43.00	45.00	48.00	42.00	53.21	43.33
52	$N_3P_0K_3$	68.80	50.00	45.00	38.00	33.60	43.36	40.00	41.25	45.00	66.67	70.00	71.67	51.11
53	$N_3P_1K_0$	65.00	74.04	62.00	56.00	55.00	42.00	41.25	51.25	47.50	63.33	61.00	60.00	56.53
54	$N_3P_1K_1$	75.00	77.00	55.00	40.96	38.80	48.80	45.00	44.00	46.25	50.00	45.00	63.33	52.43
55	$N_3P_1K_2$	102.00	100.00	85.00	62.50	59.00	46.00	57.50	58.00	62.00	73.00	90.00	106.67	75.14
56	$N_3P_1K_3$	112.00	123.00	108.00	75.00	67.50	63.50	71.00	67.00	76.67	78.75	87.50	96.25	85.51
57	$N_3P_2K_0$	50.00	43.80	40.00	45.00	25.00	37.00	45.00	42.96	45.00	55.00	45.00	48.33	43.51
58	$N_3P_2K_1$	102.00	105.00	63.00	60.00	57.00	47.50	48.50	50.00	53.33	54.00	65.00	63.33	64.06
59	$N_3P_2K_2$	94.80	108.48	84.50	75.00	64.80	76.30	80.92	84.00	82.75	85.70	89.80	90.50	84.80
60	$N_3P_2K_3$	64.00	68.80	50.00	51.00	34.00	31.00	36.00	38.00	46.25	62.50	57.50	62.50	50.13
61	$N_3P_3K_0$	62.50	50.00	55.00	40.00	33.26	25.00	30.00	42.50	47.50	50.00	43.00	62.00	45.06
62	$N_3P_3K_1$	60.00	50.00	33.30	45.00	40.00	45.00	46.00	35.00	49.00	40.00	41.67	60.00	45.41
63	$N_3P_3K_2$	58.00	70.00	63.50	50.00	49.00	46.50	48.50	55.00	56.67	50.00	53.33	63.61	55.34
64	$N_3P_3K_3$	62.50	85.00	82.50	57.50	45.00	34.00	50.00	54.50	45.00	55.00	53.00	67.00	57.58
	Mean	77.27	75.25	61.30	51.20	44.57	45.48	48.12	50.72	54.50	60.23	63.40	70.66	58.55
	%CV	25.81	24.72	24.11	22.55	25.30	25.77	24.11	23.84	18.54	22.00	25.21	27.50	18.92

Appendix XLIX. Monthly production of latex (cc/tree/tap) in block-3 of site-1 during October 1994 to September 1995.

SL	Treatment	1994			1995									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	75.00	70.00	40.00	44.12	37.50	33.30	25.00	25.00	33.33	30.00	45.00	50.00	42.35
2	$N_0P_0K_1$	62.00	72.54	50.00	41.70	40.00	35.00	41.66	42.50	47.17	46.00	54.00	48.00	48.38
3	$N_0P_0K_2$	95.00	85.00	80.00	33.00	37.60	50.00	40.00	37.50	43.33	50.00	55.00	83.33	57.48
4	$N_0P_0K_3$	85.00	80.00	60.00	51.00	46.00	41.76	30.00	45.00	50.00	80.00	75.00	73.00	59.73
5	$N_0P_1K_0$	70.00	57.00	50.00	40.00	34.00	36.00	37.50	38.30	43.00	55.00	72.00	63.60	49.70
6	$N_0P_1K_1$	53.30	46.70	43.30	40.00	37.00	36.70	36.00	42.50	50.00	51.53	55.00	57.50	45.79
7	$N_0P_1K_2$	90.00	95.00	75.00	72.50	53.0	63.80	70.00	66.00	72.50	68.70	90.00	104.00	76.78
8	$N_0P_1K_3$	80.00	75.00	87.50	55.00	53.80	48.80	51.35	46.00	55.00	60.00	75.00	70.00	63.12
9	$N_0P_2K_0$	60.00	61.00	50.00	50.00	37.50	42.00	40.00	41.00	42.60	53.00	56.00	60.00	49.43
10	$N_0P_2K_1$	75.00	73.20	60.00	59.00	53.80	46.00	57.50	56.67	60.00	73.00	116.67	127.00	71.49
11	$N_0P_2K_2$	58.00	48.00	40.00	25.00	31.30	30.00	33.75	36.00	41.50	50.00	50.98	53.75	41.52
12	$N_0P_2K_3$	80.00	75.00	87.50	55.00	50.00	66.70	47.50	48.33	60.00	65.00	60.00	75.00	64.17
13	$N_0P_3K_0$	93.00	89.00	65.00	50.00	34.50	42.50	45.00	57.50	63.75	73.75	80.00	90.96	65.91
14	$N_0P_3K_1$	75.12	70.00	63.30	60.00	50.65	41.30	32.50	43.30	50.33	55.00	50.00	63.00	54.54
15	$N_0P_3K_2$	60.00	65.00	64.00	40.96	54.15	58.00	47.00	56.00	60.67	50.00	60.00	66.67	56.87
16	$N_0P_3K_3$	68.38	70.50	62.50	47.50	55.40	46.70	45.00	48.33	53.33	67.50	71.00	70.00	58.85
17	$N_1P_0K_0$	83.80	81.30	70.00	56.70	50.00	45.00	46.00	46.77	49.00	53.35	51.25	50.00	56.93
18	$N_1P_0K_1$	62.00	50.00	36.70	46.70	50.00	37.50	35.00	33.66	50.00	52.50	48.75	53.00	46.32
19	$N_1P_0K_2$	80.00	70.00	30.00	36.82	25.00	37.50	30.00	62.50	61.67	62.50	55.00	50.00	50.08
20	$N_1P_0K_3$	90.00	75.00	50.00	45.00	22.00	40.00	48.00	47.50	42.50	43.33	50.67	56.00	50.83
21	$N_1P_1K_0$	60.00	57.58	55.00	40.00	36.70	53.30	46.66	50.00	55.00	56.00	60.00	64.00	52.85
22	$N_1P_1K_1$	76.00	61.70	63.30	53.50	50.00	60.00	45.00	56.67	55.00	60.00	61.00	63.00	58.76
23	$N_1P_1K_2$	70.00	91.70	53.30	55.00	46.90	25.00	32.50	34.50	50.50	65.00	60.00	70.00	54.53
24	$N_1P_1K_3$	75.00	57.50	41.70	50.00	36.70	46.70	46.66	47.50	51.25	66.67	58.33	75.00	54.42
25	$N_1P_2K_0$	95.00	103.30	60.00	55.00	53.30	40.00	57.50	50.67	57.56	50.00	58.00	61.30	61.80
26	$N_1P_2K_1$	75.00	113.30	104.00	83.30	68.66	60.00	50.00	60.00	66.67	72.98	75.00	90.96	76.66
27	$N_1P_2K_2$	106.00	110.00	78.00	77.00	75.00	60.00	55.00	62.00	67.50	70.00	67.25	98.00	77.15
28	$N_1P_2K_3$	101.00	98.00	80.00	70.00	60.00	50.00	57.58	65.75	62.50	80.00	117.33	105.00	78.93
29	$N_1P_3K_0$	100.00	80.00	70.00	60.00	33.26	36.30	47.50	45.00	37.50	56.00	51.00	65.00	56.80
30	$N_1P_3K_1$	98.00	80.00	60.00	50.00	45.00	46.00	55.00	57.00	60.00	65.00	67.50	63.33	62.24
31	$N_1P_3K_2$	77.00	55.00	60.00	50.00	46.78	56.70	55.00	40.00	46.25	55.00	51.00	59.00	54.31
32	$N_1P_3K_3$	87.92	75.00	63.00	50.00	51.00	35.00	36.76	45.00	51.44	52.50	58.00	67.00	56.05
33	$N_2P_0K_0$	115.00	105.00	60.00	66.70	50.00	45.00	31.25	41.25	57.00	62.50	50.50	60.00	62.02

(Contd. Appendix XLIX.)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	125.00	70.00	60.00	30.00	25.00	45.00	53.33	45.00	52.00	58.00	62.00	65.00	57.53
35	$N_2P_0K_2$	120.00	110.00	90.00	63.30	42.50	50.00	54.00	52.50	56.00	60.00	64.00	73.33	69.64
36	$N_2P_0K_3$	105.00	125.00	60.00	50.00	55.00	50.00	51.00	45.00	64.00	71.00	73.00	76.00	68.75
37	$N_2P_1K_0$	95.00	100.00	75.00	45.00	31.42	32.30	25.00	32.50	25.00	35.00	49.00	35.00	48.35
38	$N_2P_1K_1$	90.00	92.00	52.00	70.00	60.00	50.00	25.00	20.00	25.00	50.00	55.00	50.00	53.25
39	$N_2P_1K_2$	53.80	43.30	45.00	43.30	22.14	23.50	34.00	45.00	47.50	53.00	47.00	55.00	42.71
40	$N_2P_1K_3$	90.00	75.00	60.00	50.00	35.00	39.00	37.50	41.00	54.00	70.00	86.25	91.00	60.73
41	$N_2P_2K_0$	64.42	70.00	53.30	30.00	50.00	40.00	37.50	38.33	43.66	50.00	38.00	45.00	46.68
42	$N_2P_2K_1$	62.50	60.00	35.00	40.00	45.00	43.20	37.50	34.00	50.00	60.00	52.00	64.00	48.60
43	$N_2P_2K_2$	61.30	65.60	55.00	35.00	31.00	29.00	41.66	36.67	43.66	40.00	45.00	50.00	44.49
44	$N_2P_2K_3$	69.00	50.00	40.00	36.00	36.00	37.00	47.00	54.00	54.70	56.67	57.50	65.00	50.24
45	$N_2P_3K_0$	85.00	65.00	55.00	56.00	53.30	54.00	44.00	46.00	50.00	30.00	37.50	45.00	51.73
46	$N_2P_3K_1$	95.00	90.00	65.00	55.00	54.00	53.50	50.00	53.92	60.00	65.00	72.50	83.33	66.44
47	$N_2P_3K_2$	110.00	100.00	90.00	62.50	50.00	68.70	57.50	67.50	69.00	76.50	80.50	90.00	76.85
48	$N_2P_3K_3$	95.00	100.00	85.00	65.00	50.00	51.00	45.00	47.50	52.50	59.00	51.00	49.00	62.50
49	$N_3P_0K_0$	75.00	83.00	50.00	40.00	37.80	35.00	33.00	47.00	54.00	60.00	66.00	55.12	52.99
50	$N_3P_0K_1$	60.00	53.64	50.00	43.00	40.00	30.00	32.50	33.00	45.00	50.83	47.50	55.00	45.04
51	$N_3P_0K_2$	80.00	83.80	75.00	50.00	42.50	37.00	38.00	37.82	49.00	51.00	53.00	53.66	54.23
52	$N_3P_0K_3$	90.00	105.00	110.00	60.00	37.50	30.00	37.00	54.00	56.00	65.00	76.79	65.00	65.52
53	$N_3P_1K_0$	62.00	55.50	50.50	45.00	42.50	43.72	42.50	42.00	46.00	57.48	67.00	70.96	52.10
54	$N_3P_1K_1$	50.00	33.42	50.00	35.00	25.00	26.00	37.75	35.00	39.00	41.00	51.00	63.00	40.51
55	$N_3P_1K_2$	55.00	50.00	43.30	40.00	42.50	44.50	43.75	30.48	51.33	56.67	45.00	50.00	46.04
56	$N_3P_1K_3$	75.32	58.00	60.00	50.00	54.00	50.00	41.25	36.75	47.80	51.56	57.00	60.96	49.94
57	$N_3P_2K_0$	85.86	79.00	54.00	60.00	40.00	40.00	40.30	43.00	50.00	57.50	69.17	70.00	57.40
58	$N_3P_2K_1$	98.00	88.80	87.50	80.00	57.00	60.00	65.00	64.00	71.44	95.00	97.50	83.33	78.96
59	$N_3P_2K_2$	112.00	110.00	82.50	60.00	50.00	40.00	55.00	63.00	77.00	93.00	98.75	97.50	78.23
60	$N_3P_2K_3$	91.00	76.00	59.00	51.00	49.00	38.80	46.25	40.00	45.00	58.00	49.00	62.83	55.49
61	$N_3P_3K_0$	96.30	90.00	72.50	55.00	35.00	25.00	40.00	46.67	48.75	50.00	66.67	70.00	57.99
62	$N_3P_3K_1$	55.00	50.00	43.66	40.00	45.00	41.30	32.50	33.00	28.00	30.00	33.00	35.00	38.87
63	$N_3P_3K_2$	75.00	51.00	49.00	42.50	40.00	25.00	26.00	30.25	30.00	45.00	51.00	53.00	43.15
64	$N_3P_3K_3$	99.00	86.00	80.00	57.50	58.50	49.00	47.50	52.50	56.25	58.00	71.70	80.00	66.33
Mean		81.28	76.04	61.57	50.79	44.44	43.35	43.02	45.52	51.24	57.73	61.89	66.31	57.01
%CV		22.02	26.57	27.43	24.03	24.44	24.56	22.91	22.78	20.69	22.12	27.00	26.09	18.37

Appendix L. Monthly production of latex (cc/tree/tap) in block-1 of site -1 during October 1995 to September 1996.

SL	Treatment	1995			1996									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	75.00	65.00	60.00	57.16	59.00	55.00	58.00	60.00	65.70	72.65	75.00	87.50	65.83
2	$N_0P_0K_1$	80.00	71.00	69.00	63.75	61.25	64.00	66.00	83.00	80.00	70.00	87.00	76.25	72.60
3	$N_0P_0K_2$	63.00	67.83	56.67	50.00	46.67	50.00	47.50	66.67	60.00	70.83	60.73	90.00	60.83
4	$N_0P_0K_3$	63.33	70.00	63.50	57.50	60.00	63.33	55.00	60.00	47.50	55.00	70.00	62.33	60.62
5	$N_0P_1K_0$	62.50	60.00	75.00	75.00	50.00	36.43	62.50	72.50	57.74	75.00	60.00	80.00	63.89
6	$N_0P_1K_1$	110.00	89.00	90.00	75.00	51.00	59.00	41.67	50.00	56.00	75.00	67.00	83.00	70.56
7	$N_0P_1K_2$	120.00	100.00	88.75	70.00	63.33	57.50	63.00	60.00	65.00	79.00	78.00	110.00	79.55
8	$N_0P_1K_3$	70.00	83.00	73.66	33.66	26.67	32.36	48.00	50.00	52.00	62.00	57.90	63.00	54.35
9	$N_0P_2K_0$	70.00	80.00	50.00	37.50	50.00	52.16	50.25	48.00	70.00	73.00	90.00	70.39	61.78
10	$N_0P_2K_1$	116.67	76.00	80.00	60.00	47.50	62.50	68.75	65.00	66.25	60.00	80.00	70.00	71.06
11	$N_0P_2K_2$	70.00	80.00	75.00	50.00	48.75	55.00	50.00	54.00	51.00	60.00	55.00	60.00	59.06
12	$N_0P_2K_3$	75.00	90.00	105.00	70.00	80.00	35.00	56.25	67.00	50.00	83.00	110.00	83.33	75.38
13	$N_0P_3K_0$	90.00	85.00	90.00	85.00	70.00	63.33	65.00	60.00	85.00	100.00	105.00	113.75	84.34
14	$N_0P_3K_1$	110.00	95.00	90.00	70.00	60.00	70.00	62.50	60.00	110.00	90.00	142.00	140.00	91.63
15	$N_0P_3K_2$	100.00	140.00	100.00	80.00	45.00	75.00	55.00	68.75	90.00	120.00	103.00	120.75	91.46
16	$N_0P_3K_3$	95.00	93.00	72.00	60.00	50.00	56.00	62.50	70.00	75.04	109.00	100.00	105.00	78.96
17	$N_1P_0K_0$	100.00	105.00	100.00	62.50	63.00	60.60	62.00	75.00	65.00	70.00	73.00	103.00	78.26
18	$N_1P_0K_1$	105.00	110.00	92.50	75.00	62.50	65.00	61.67	66.67	57.77	76.00	71.74	74.39	76.52
19	$N_1P_0K_2$	114.00	100.00	62.50	70.00	76.00	79.00	81.00	60.00	75.00	84.92	106.67	110.00	84.92
20	$N_1P_0K_3$	81.25	105.00	100.00	70.00	71.00	59.00	72.00	75.00	85.00	62.50	67.50	68.00	76.35
21	$N_1P_1K_0$	95.00	75.00	100.00	73.00	66.67	60.00	66.67	67.00	67.34	60.00	76.67	96.00	75.28
22	$N_1P_1K_1$	110.00	125.00	115.00	85.00	61.25	47.50	58.33	61.67	96.25	87.50	95.00	110.00	87.71
23	$N_1P_1K_2$	96.67	90.00	110.00	62.50	50.00	33.83	47.00	53.75	60.00	57.50	62.50	65.00	65.73
24	$N_1P_1K_3$	105.00	83.33	75.00	59.96	60.00	65.00	68.00	65.00	69.00	76.00	102.00	130.00	79.86
25	$N_1P_2K_0$	115.00	136.36	116.67	76.67	50.00	65.00	70.00	75.00	80.00	107.65	110.00	121.00	93.61
26	$N_1P_2K_1$	93.33	78.33	100.00	60.00	47.50	45.00	58.35	60.00	65.00	75.00	70.00	85.00	69.79
27	$N_1P_2K_2$	120.00	110.00	130.39	75.00	100.00	50.00	62.50	67.00	83.00	86.67	107.50	110.50	91.88
28	$N_1P_2K_3$	95.00	120.00	75.00	68.75	50.00	55.00	75.00	70.00	62.50	108.33	100.00	80.00	79.97
29	$N_1P_3K_0$	100.00	105.00	60.00	56.67	49.00	50.00	45.00	35.96	45.00	49.39	53.00	63.67	59.39
30	$N_1P_3K_1$	53.00	67.00	51.00	50.00	47.00	29.67	25.00	49.00	50.00	58.94	56.67	50.00	48.94
31	$N_1P_3K_2$	90.00	87.50	75.00	53.96	47.00	40.50	53.33	50.00	70.00	65.62	62.50	80.00	64.62
32	$N_1P_3K_3$	72.00	65.00	63.00	57.00	35.00	38.00	50.00	46.67	66.67	61.52	90.00	93.33	61.52
33	$N_2P_0K_0$	56.00	80.00	58.00	59.24	53.30	45.33	45.00	52.50	66.00	70.00	75.00	60.67	60.09

(Contd. Appendix- L)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	89.00	95.00	90.00	65.00	55.47	63.00	65.00	63.66	71.00	61.83	65.00	78.00	**71.83**
35	$N_2P_0K_2$	100.00	95.00	91.80	69.00	66.00	64.00	55.24	65.00	75.00	76.00	82.00	80.00	**76.59**
36	$N_2P_0K_3$	110.00	85.00	83.66	73.00	37.70	54.57	55.00	65.00	66.67	73.00	81.00	89.00	**72.80**
37	$N_2P_1K_0$	76.67	70.00	66.48	65.00	44.00	40.00	55.00	61.00	65.00	77.00	79.00	76.67	**64.65**
38	$N_2P_1K_1$	125.00	100.00	85.00	74.00	58.46	55.00	60.00	65.00	55.00	77.00	75.00	98.00	**77.29**
39	$N_2P_1K_2$	60.00	75.00	100.00	62.50	34.67	38.00	45.67	51.00	59.00	57.80	58.00	52.00	**57.80**
40	$N_2P_1K_3$	87.50	80.00	73.00	50.00	35.33	45.00	51.66	36.00	34.00	51.00	54.00	65.00	**55.21**
41	$N_2P_2K_0$	56.00	67.00	58.00	40.00	30.00	29.00	45.00	43.00	48.00	54.00	50.00	60.00	**48.33**
42	$N_2P_2K_1$	63.00	75.00	52.00	49.00	50.00	26.00	48.00	52.00	42.50	45.00	46.00	49.00	**49.79**
43	$N_2P_2K_2$	75.00	77.09	86.00	55.00	47.50	50.90	50.00	47.00	50.00	61.80	59.00	76.67	**61.33**
44	$N_2P_2K_3$	84.68	63.00	52.00	48.33	40.00	40.00	45.00	47.00	49.40	49.00	41.00	44.00	**50.28**
45	$N_2P_3K_0$	70.00	110.00	130.00	60.00	30.00	45.00	58.33	45.00	52.00	55.00	90.50	70.00	**67.99**
46	$N_2P_3K_1$	75.00	90.00	60.00	40.00	50.00	47.50	46.00	44.00	56.25	62.50	70.00	75.00	**59.69**
47	$N_2P_3K_2$	103.00	80.00	82.83	59.00	48.33	63.00	59.67	60.00	70.00	86.89	90.00	119.96	**76.89**
48	$N_2P_3K_3$	90.00	97.50	65.00	45.00	58.00	50.00	44.70	54.50	65.00	63.59	63.04	66.67	**63.58**
49	$N_3P_0K_0$	90.00	88.00	82.00	80.00	63.37	63.69	70.00	66.67	75.00	79.00	85.00	109.92	**77.73**
50	$N_3P_0K_1$	60.00	57.50	37.50	34.00	28.00	38.00	45.00	43.82	35.00	44.00	50.00	59.00	**44.32**
51	$N_3P_0K_2$	66.67	80.00	58.00	66.00	54.67	56.00	55.00	50.67	45.33	61.00	70.00	72.63	**61.33**
52	$N_3P_0K_3$	86.00	95.00	94.00	60.00	50.00	56.67	60.00	68.33	75.00	75.45	90.00	95.00	**75.45**
53	$N_3P_1K_0$	60.00	80.00	75.00	46.00	44.00	41.00	43.00	41.00	52.00	68.00	80.00	75.00	**58.75**
54	$N_3P_1K_1$	100.00	137.50	125.00	102.50	56.67	63.33	75.00	74.00	67.67	70.00	99.00	92.67	**88.61**
55	$N_3P_1K_2$	79.00	71.00	66.00	64.00	51.50	54.50	56.00	64.00	61.00	57.50	66.67	70.00	**63.43**
56	$N_3P_1K_3$	125.00	123.00	120.00	72.50	55.30	60.00	61.00	69.00	75.00	80.00	93.75	96.00	**85.88**
57	$N_3P_2K_0$	54.00	60.00	71.67	30.00	25.00	27.00	35.50	33.00	33.66	28.00	47.00	33.33	**39.85**
58	$N_3P_2K_1$	150.00	110.67	125.00	120.00	80.00	61.02	66.67	70.00	90.00	105.00	150.00	210.00	**111.53**
59	$N_3P_2K_2$	113.33	150.00	135.00	70.00	60.00	55.00	60.00	75.00	71.00	74.00	70.00	92.50	**85.49**
60	$N_3P_2K_3$	77.00	92.50	67.00	63.58	33.66	25.00	50.00	53.00	50.00	59.00	76.00	80.00	**60.56**
61	$N_3P_3K_0$	91.00	100.00	99.00	78.00	52.00	45.00	50.00	54.00	59.36	61.00	64.00	75.00	**69.03**
62	$N_3P_3K_1$	78.00	73.00	57.61	50.00	35.00	45.00	56.00	50.48	67.00	65.00	63.00	71.00	**59.26**
63	$N_3P_3K_2$	72.50	85.00	97.00	53.00	50.00	41.00	49.00	65.00	60.00	90.00	61.00	74.00	**66.46**
64	$N_3P_3K_3$	98.00	75.00	50.00	49.00	50.00	47.00	40.00	43.00	52.40	53.50	64.50	71.00	**57.78**
Mean		88.08	89.45	82.17	62.55	52.08	51.02	55.77	58.52	63.64	70.84	77.54	83.95	69.65

Appendix LI. Monthly production of latex (cc/tree/tap) in block -2 of site-1 during October 1995 to September 1996.

SL	Treatment	1995			1996									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	70.00	85.00	76.25	65.00	52.50	50.00	55.00	56.67	60.00	51.00	59.00	73.30	62.81
2	$N_0P_0K_1$	110.00	112.50	92.00	70.00	63.75	61.00	67.50	62.50	87.50	75.00	99.45	120.00	85.10
3	$N_0P_0K_2$	62.50	66.67	58.90	50.00	34.00	40.00	33.33	53.00	77.83	75.00	66.67	77.50	57.95
4	$N_0P_0K_3$	87.50	75.00	66.67	80.00	60.00	56.67	63.33	70.00	73.33	77.00	70.00	83.00	71.88
5	$N_0P_1K_0$	89.00	87.00	91.40	50.00	25.48	45.00	45.50	67.00	83.00	70.00	85.00	77.00	67.95
6	$N_0P_1K_1$	87.00	71.00	60.00	75.00	65.00	65.92	66.67	75.00	90.00	74.00	77.00	80.21	73.90
7	$N_0P_1K_2$	120.00	110.00	100.00	75.00	65.00	60.00	68.30	75.00	95.00	100.00	125.00	126.67	93.33
8	$N_0P_1K_3$	54.67	76.00	77.00	50.50	50.00	50.67	51.00	55.25	56.00	50.67	66.00	70.00	58.98
9	$N_0P_2K_0$	97.00	100.00	90.00	50.00	44.00	53.00	50.33	58.19	52.00	50.00	83.00	97.00	68.71
10	$N_0P_2K_1$	130.00	100.00	80.00	60.00	45.00	62.00	62.50	75.00	65.00	70.00	100.00	92.50	78.50
11	$N_0P_2K_2$	85.00	75.00	62.54	43.75	43.00	37.50	54.00	50.00	66.67	57.50	60.00	70.00	58.75
12	$N_0P_2K_3$	115.00	105.00	100.00	63.44	43.00	48.00	52.00	53.00	60.00	65.00	89.68	110.31	75.37
13	$N_0P_3K_0$	92.00	102.50	60.00	58.33	37.50	45.00	47.50	57.50	68.00	70.00	80.00	75.00	66.11
14	$N_0P_3K_1$	86.00	97.00	83.38	62.50	54.00	56.00	69.00	67.50	80.00	72.50	90.00	104.00	76.82
15	$N_0P_3K_2$	108.80	103.00	90.00	66.00	62.00	66.67	70.00	78.00	72.00	86.00	89.36	96.85	82.39
16	$N_0P_3K_3$	74.00	85.00	69.00	62.50	58.33	66.67	59.00	75.00	80.00	87.50	77.50	87.00	73.46
17	$N_1P_0K_0$	82.50	80.00	90.00	80.00	67.50	75.00	67.66	74.00	77.00	90.75	95.00	126.00	83.78
18	$N_1P_0K_1$	90.00	100.00	98.00	80.00	60.00	62.50	79.00	77.00	83.50	76.00	65.00	86.50	79.79
19	$N_1P_0K_2$	110.00	100.00	87.50	70.00	52.00	71.25	77.50	75.50	92.50	113.33	114.50	123.00	90.59
20	$N_1P_0K_3$	80.00	65.00	75.00	50.00	26.67	36.67	43.33	55.32	60.00	63.00	72.34	70.00	58.11
21	$N_1P_1K_0$	127.00	105.00	98.00	70.00	48.00	54.06	78.50	85.00	104.00	106.00	107.00	120.00	91.88
22	$N_1P_1K_1$	130.00	146.67	75.00	62.50	40.00	37.50	50.00	58.33	75.00	71.00	85.00	89.00	76.67
23	$N_1P_1K_2$	80.00	63.00	60.00	55.00	40.00	45.00	32.00	62.00	70.00	80.88	70.00	84.00	61.82
24	$N_1P_1K_3$	110.00	100.00	78.07	66.67	32.50	45.00	50.00	75.00	76.60	80.00	100.00	114.00	77.32
25	$N_1P_2K_0$	113.00	120.00	80.00	60.00	45.36	55.00	60.00	77.00	75.00	70.00	79.00	102.00	78.03
26	$N_1P_2K_1$	117.50	112.50	80.00	68.75	65.00	75.00	60.00	70.00	85.00	93.00	83.66	115.00	85.45
27	$N_1P_2K_2$	109.00	110.00	66.67	60.00	35.00	59.00	68.00	70.00	67.50	75.00	73.00	99.40	74.38
28	$N_1P_2K_3$	90.00	83.33	102.54	60.00	36.00	30.00	44.00	40.00	67.20	70.00	83.33	100.00	67.20
29	$N_1P_3K_0$	84.92	79.00	65.00	46.25	45.00	47.00	55.18	58.66	63.00	75.00	90.00	96.67	67.14
30	$N_1P_3K_1$	85.50	81.00	78.00	60.33	41.67	53.00	43.66	60.33	66.96	70.00	78.00	99.00	68.12
31	$N_1P_3K_2$	99.48	125.00	81.25	50.00	66.67	50.33	83.00	87.98	90.00	100.00	105.33	143.00	90.17
32	$N_1P_3K_3$	110.00	100.00	60.00	43.75	57.00	70.00	76.68	67.00	77.00	79.00	93.00	87.00	76.70
33	$N_2P_0K_0$	75.00	78.00	66.67	41.67	51.00	62.00	58.00	49.00	50.00	62.50	59.50	66.67	60.00

(Contd. Appendix LI)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	83.00	100.00	93.66	66.67	62.50	75.00	70.00	80.00	83.33	75.00	79.00	96.00	80.35
35	$N_2P_0K_2$	145.00	140.00	100.00	93.75	75.00	63.63	69.00	93.00	72.00	74.00	95.00	101.78	93.51
36	$N_2P_0K_3$	91.00	75.00	93.33	44.65	56.00	46.67	57.50	60.00	65.00	74.00	82.50	86.67	69.36
37	$N_2P_1K_0$	70.00	66.67	50.00	30.00	20.00	37.00	47.00	53.93	57.00	70.00	77.00	85.00	55.30
38	$N_2P_1K_1$	137.00	91.00	92.50	75.00	63.00	70.00	68.00	80.00	75.00	98.92	87.00	125.00	88.54
39	$N_2P_1K_2$	62.50	65.00	50.00	60.00	37.50	25.00	45.00	40.00	70.00	65.00	68.00	72.00	55.00
40	$N_2P_1K_3$	63.50	61.00	62.00	37.50	33.00	36.00	44.00	49.00	53.38	50.00	52.00	63.62	50.42
41	$N_2P_2K_0$	109.00	95.00	90.00	80.00	30.00	45.00	54.00	58.00	66.00	67.34	75.00	99.00	72.36
42	$N_2P_2K_1$	65.00	70.00	55.00	53.00	57.00	56.67	38.67	50.00	54.00	66.00	68.00	75.00	59.03
43	$N_2P_2K_2$	88.00	92.50	90.00	76.67	62.50	60.00	65.00	75.00	70.00	76.67	102.00	105.00	80.28
44	$N_2P_2K_3$	93.00	80.00	72.50	56.25	30.00	50.00	53.00	55.33	65.00	60.00	72.00	65.00	64.34
45	$N_2P_3K_0$	70.00	80.00	60.50	77.00	66.67	62.50	60.00	75.00	67.00	72.83	73.00	98.00	71.88
46	$N_2P_3K_1$	100.00	95.00	87.50	85.00	84.66	100.00	83.33	116.67	100.00	116.67	96.67	122.00	98.96
47	$N_2P_3K_2$	75.00	92.00	84.00	60.00	36.25	35.00	31.00	40.00	35.00	74.00	81.00	80.50	60.31
48	$N_2P_3K_3$	60.00	53.75	56.67	50.00	46.64	45.00	52.00	43.96	51.50	59.00	64.00	73.00	54.63
49	$N_3P_0K_0$	80.00	100.00	87.50	50.00	37.00	33.83	75.00	87.50	75.00	62.50	66.67	50.00	67.08
50	$N_3P_0K_1$	75.00	74.00	68.00	50.00	33.00	25.00	30.00	32.00	37.50	50.00	60.00	63.00	49.79
51	$N_3P_0K_2$	70.96	83.33	62.50	43.30	58.00	58.66	64.75	63.00	70.34	64.69	62.96	73.75	64.69
52	$N_3P_0K_3$	72.50	75.00	60.00	35.00	20.00	37.00	33.00	45.00	67.50	56.00	74.00	85.00	55.00
53	$N_3P_1K_0$	75.00	90.00	71.67	62.00	33.00	46.67	55.00	66.66	73.00	71.33	91.00	98.00	69.44
54	$N_3P_1K_1$	64.00	56.25	57.75	61.00	36.00	50.00	47.00	55.00	57.00	60.00	87.00	93.83	60.40
55	$N_3P_1K_2$	119.00	89.00	96.00	66.00	52.00	66.00	65.64	80.00	77.00	86.00	89.00	98.00	81.97
56	$N_3P_1K_3$	135.00	125.00	112.00	110.00	79.08	84.00	86.00	103.00	115.00	116.00	125.00	112.00	108.51
57	$N_3P_2K_0$	81.50	81.00	70.00	40.00	50.00	55.23	38.67	41.25	56.97	58.00	62.00	70.00	58.72
58	$N_3P_2K_1$	100.00	110.00	117.00	93.00	70.00	68.00	91.30	75.72	90.00	94.00	113.00	133.00	96.25
59	$N_3P_2K_2$	148.00	150.00	160.00	80.00	70.00	90.00	110.00	102.00	112.00	110.00	128.00	125.00	115.42
60	$N_3P_2K_3$	68.00	76.67	57.00	56.00	35.00	50.00	53.40	50.00	55.00	58.00	60.00	65.00	57.01
61	$N_3P_3K_0$	70.00	93.75	70.00	55.00	52.00	53.00	51.00	41.50	45.00	46.00	55.00	74.00	58.85
62	$N_3P_3K_1$	46.08	50.00	55.00	50.00	47.00	45.00	50.00	40.00	41.00	48.00	49.00	50.00	47.59
63	$N_3P_3K_2$	56.50	66.67	60.00	50.00	33.66	33.88	50.00	47.00	42.00	43.00	53.33	69.00	50.42
64	$N_3P_3K_3$	91.67	85.00	93.00	75.00	68.00	70.00	67.00	65.00	70.00	87.50	95.34	120.00	82.29
Mean		91.06	90.03	78.66	61.39	49.16	54.16	58.54	64.60	70.55	73.70	81.48	92.32	72.14
%CV		25.89	23.53	24.38	24.73	30.39	27.80	26.67	26.26	23.52	23.60	22.42	22.90	20.31

Appendix LII. Monthly production of latex (cc/tree/tap) in block-3 of site -1 during October 1995 to September 1996.

SL	Treatment	1995			1996									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	67.00	63.00	61.00	60.00	50.00	55.00	53.00	52.00	63.00	70.00	65.00	68.80	60.65
2	$N_0P_0K_1$	83.00	80.00	66.67	57.00	50.00	40.00	48.00	61.00	74.00	64.00	65.00	78.00	63.89
3	$N_0P_0K_2$	72.00	70.00	77.96	53.75	45.00	50.00	54.00	92.50	80.00	74.00	72.00	116.67	71.49
4	$N_0P_0K_3$	94.00	78.50	83.00	63.00	50.00	56.66	60.00	73.00	76.72	85.00	100.00	101.00	76.74
5	$N_0P_1K_0$	91.00	90.00	95.00	60.00	50.00	54.00	55.00	68.75	58.33	96.67	100.00	110.00	77.40
6	$N_0P_1K_1$	76.00	82.00	78.00	75.00	50.00	37.50	75.00	63.75	68.75	61.25	73.00	79.08	68.28
7	$N_0P_1K_2$	120.00	100.00	120.00	90.00	86.25	90.00	66.67	86.00	80.00	90.00	92.00	95.60	93.04
8	$N_0P_1K_3$	100.00	87.00	70.00	65.00	55.00	42.50	57.50	50.00	70.08	85.00	75.00	91.00	70.67
9	$N_0P_2K_0$	75.48	60.00	56.67	47.56	50.00	40.00	45.00	55.00	50.00	59.39	66.00	74.00	56.59
10	$N_0P_2K_1$	102.95	75.54	75.00	67.50	40.00	60.00	55.00	64.70	56.00	97.00	100.00	90.00	73.64
11	$N_0P_2K_2$	71.52	75.00	70.00	66.67	50.00	25.00	45.00	55.00	59.00	65.00	75.00	81.00	61.52
12	$N_0P_2K_3$	130.00	110.00	115.00	112.50	75.00	62.50	66.67	70.00	67.50	87.50	97.50	110.00	92.01
13	$N_0P_3K_0$	74.96	105.00	100.00	80.00	75.00	37.50	50.00	62.50	67.50	81.25	82.50	100.00	76.35
14	$N_0P_3K_1$	70.00	80.00	90.00	51.30	46.00	46.00	60.00	75.00	65.00	73.00	75.00	77.00	67.36
15	$N_0P_3K_2$	76.00	70.00	60.00	49.00	43.75	35.00	50.00	55.00	66.29	71.00	85.00	82.50	61.96
16	$N_0P_3K_3$	90.00	94.00	66.00	63.74	50.44	41.67	54.00	56.00	66.67	75.00	80.00	76.62	67.85
17	$N_1P_0K_0$	90.00	65.00	71.00	58.00	50.00	41.68	56.71	54.00	66.67	77.00	90.00	94.00	67.84
18	$N_1P_0K_1$	75.00	58.67	66.67	46.50	56.67	58.00	60.00	61.00	68.00	72.00	65.00	66.67	62.85
19	$N_1P_0K_2$	110.00	80.00	87.50	75.00	60.00	66.00	65.00	62.50	80.33	75.00	100.00	103.00	80.36
20	$N_1P_0K_3$	86.00	91.00	75.00	65.75	50.00	52.00	55.00	59.00	75.00	68.00	87.50	83.66	70.66
21	$N_1P_1K_0$	90.00	72.00	66.00	55.00	50.00	40.00	50.00	62.50	75.00	79.00	90.00	100.00	69.13
22	$N_1P_1K_1$	100.00	125.00	70.00	60.00	50.00	45.00	55.00	49.00	51.00	65.61	66.67	50.00	65.61
23	$N_1P_1K_2$	69.00	66.96	60.67	50.00	37.50	57.59	55.00	45.00	46.00	54.83	56.67	58.71	54.83
24	$N_1P_1K_3$	89.00	80.00	60.00	55.00	46.00	56.67	53.42	56.67	75.00	65.71	66.67	85.00	65.76
25	$N_1P_2K_0$	121.67	105.00	90.00	73.67	71.00	80.00	70.00	83.33	90.00	96.51	112.00	125.00	93.18
26	$N_1P_2K_1$	86.00	120.00	112.50	87.50	62.50	65.48	75.00	77.50	87.00	107.00	113.00	102.75	91.35
27	$N_1P_2K_2$	110.00	108.00	120.00	110.00	60.00	65.00	57.50	90.00	102.00	112.74	100.00	115.00	95.85
28	$N_1P_2K_3$	112.50	120.00	100.00	97.50	66.67	65.00	71.00	83.33	67.50	100.00	115.67	101.73	91.74
29	$N_1P_3K_0$	80.00	81.00	73.00	60.00	50.00	43.75	50.00	62.50	60.00	67.33	72.00	75.00	64.55
30	$N_1P_3K_1$	80.00	65.50	62.00	60.00	67.50	65.00	70.00	66.67	69.00	70.00	81.00	100.00	71.39
31	$N_1P_3K_2$	96.00	76.67	61.00	60.00	68.75	75.00	76.00	87.50	72.50	85.68	101.00	104.50	80.38
32	$N_1P_3K_3$	90.00	84.00	80.00	60.00	56.00	58.79	66.67	75.00	85.00	95.00	93.00	97.00	78.37

(Contd. Appendix LII)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	130.00	120.00	100.00	75.00	82.50	62.50	65.00	71.72	79.00	95.00	96.00	120.00	91.39
35	$N_2P_0K_2$	79.00	75.00	60.00	58.00	56.25	47.50	65.00	78.00	81.00	75.00	86.67	109.00	72.54
36	$N_2P_0K_3$	100.00	83.00	92.00	70.67	56.00	55.00	63.00	75.00	70.00	74.35	73.00	80.66	74.39
37	$N_2P_1K_0$	70.00	63.33	63.00	60.67	20.00	25.00	52.33	53.00	46.67	67.00	63.00	60.00	53.67
38	$N_2P_1K_1$	98.00	102.00	90.00	70.00	30.00	35.00	48.00	58.66	50.00	63.00	60.00	74.50	64.93
39	$N_2P_1K_2$	80.67	76.00	66.67	68.75	61.42	58.00	68.00	65.00	55.00	66.67	67.00	83.00	68.02
40	$N_2P_1K_3$	115.00	92.00	70.00	68.75	75.00	50.00	65.00	73.75	67.34	66.00	86.44	104.42	77.81
41	$N_2P_2K_0$	63.33	120.00	96.67	66.55	50.00	59.00	57.50	68.00	75.00	87.50	110.00	107.00	80.05
42	$N_2P_2K_1$	69.00	65.00	85.00	75.00	55.00	65.00	66.67	45.00	55.00	63.33	70.00	81.00	66.25
43	$N_2P_2K_2$	105.00	87.00	83.00	70.00	45.00	55.00	50.00	63.03	60.00	80.00	110.00	90.00	75.00
44	$N_2P_2K_3$	87.50	82.50	76.67	60.00	56.67	60.00	65.00	71.00	79.00	82.50	77.50	82.50	73.40
45	$N_2P_3K_0$	70.00	66.00	60.00	58.00	47.50	52.50	47.00	50.00	43.66	55.00	60.00	62.00	55.97
46	$N_2P_3K_1$	89.00	93.33	75.00	83.34	75.00	65.00	71.00	79.00	75.00	85.00	80.00	88.50	79.93
47	$N_2P_3K_2$	115.00	110.00	105.00	70.00	60.00	80.00	85.00	93.75	96.00	107.50	75.00	110.67	92.33
48	$N_2P_3K_3$	107.00	123.33	100.00	75.00	68.00	58.21	62.50	83.00	72.00	83.66	78.00	100.00	84..23
49	$N_3P_0K_0$	78.00	82.50	75.00	65.00	60.00	50.00	55.00	53.00	62.50	75.00	80.00	59.00	66.25
50	$N_3P_0K_1$	80.00	84.00	75.00	59.00	60.00	57.50	68.00	75.00	90.00	87.50	92.00	111.00	78.25
51	$N_3P_0K_2$	93.00	83.53	75.00	66.79	50.00	73.00	70.00	62.50	75.00	80.00	75.00	97.00	75.07
52	$N_3P_0K_3$	79.00	83.33	70.00	65.00	66.67	50.00	58.00	62.50	67.00	80.00	81.00	85.00	70.63
53	$N_3P_1K_0$	65.00	62.50	47.00	42.00	37.50	42.50	45.00	47.50	55.00	61.00	60.00	65.00	52.50
54	$N_3P_1K_1$	86.00	83.00	67.83	53.34	50.00	43.66	63.00	70.00	62.00	66.00	73.00	75.00	66.07
55	$N_3P_1K_2$	98.00	116.67	80.00	67.50	50.00	51.67	63.00	72.00	75.00	78.00	95.00	85.00	77.65
56	$N_3P_1K_3$	133.00	130.00	103.33	87.50	77.00	75.00	80.00	87.50	66.71	95.00	105.00	129.00	97.42
57	$N_3P_2K_0$	50.00	62.58	75.00	34.00	25.00	40.00	45.00	33.66	60.00	71.00	75.00	63.00	52.85
58	$N_3P_2K_1$	120.00	110.00	92.50	90.00	95.00	85.00	83.66	75.00	70.00	110.00	108.00	105.84	95.42
59	$N_3P_2K_2$	100.00	133.00	115.00	65.00	50.00	55.00	68.00	75.00	87.95	100.00	96.00	106.00	87.58
60	$N_3P_2K_3$	100.00	110.00	125.00	75.00	60.00	70.00	87.00	80.00	75.00	81.60	89.00	105.00	88.13
61	$N_3P_3K_0$	92.50	100.00	75.00	62.50	58.00	75.00	83.00	60.36	63.00	67.50	59.00	68.75	72.05
62	$N_3P_3K_1$	55.00	50.00	60.00	55.00	50.00	43.75	34.60	50.00	46.00	63.75	66.00	65.00	53.26
63	$N_3P_3K_2$	84.00	76.00	75.00	60.00	52.50	50.00	55.00	56.25	75.96	64.00	80.00	75.00	66.98
64	$N_3P_3K_3$	75.00	112.50	116.67	112.55	65.00	50.00	53.00	67.00	75.00	85.00	90.00	80.00	81.81
Mean		89.70	88.22	80.78	67.84	56.08	54.86	60.83	66.27	69.21	78.49	82.75	90.04	73.63
%CV		20.56	23.03	22.76	23.37	24.36	24.87	17.88	19.53	17.67	17.93	18.90	20.55	16.10

Appendix LIII. Monthly production of latex (cc/tree/tap) in block -1 of site -2 during October 1994 to September 1995.

SL	Treatment	1994			1995									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	90.00	43.80	54.00	40.00	46.90	36.00	23.00	41.00	59.00	35.00	63.75	50.00	48.54
2	$N_0P_0K_1$	81.30	75.00	65.00	63.00	47.00	38.35	42.50	41.25	40.00	50.00	60.00	66.67	55.84
3	$N_0P_0K_2$	68.00	70.00	62.91	58.80	53.80	52.00	50.00	58.75	52.50	50.00	65.00	60.00	58.48
4	$N_0P_0K_3$	90.00	80.00	74.00	70.00	60.00	51.90	54.00	43.28	43.70	88.50	90.00	72.50	68.16
5	$N_0P_1K_0$	70.00	80.00	70.00	40.00	50.00	40.00	51.00	57.50	70.00	76.00	53.30	60.00	59.82
6	$N_0P_1K_1$	59.00	61.00	46.98	40.00	29.00	35.00	45.00	44.29	57.00	70.00	83.33	90.00	55.05
7	$N_0P_1K_2$	81.00	79.00	60.00	39.00	50.00	30.00	31.00	58.00	57.50	65.00	63.50	85.00	58.25
8	$N_0P_1K_3$	65.00	80.00	63.00	65.00	30.00	40.00	52.60	64.59	53.71	52.00	60.00	57.50	56.95
9	$N_0P_2K_0$	75.00	55.00	32.50	28.80	51.25	50.00	46.00	45.00	60.00	85.00	71.00	79.00	56.55
10	$N_0P_2K_1$	78.00	58.00	40.00	27.50	34.15	50.00	37.50	55.00	62.50	64.17	65.00	70.00	53.49
11	$N_0P_2K_2$	74.00	95.00	62.88	58.00	36.65	35.00	38.30	45.00	52.00	50.00	58.33	60.00	55.43
12	$N_0P_2K_3$	61.00	53.00	50.00	43.00	37.50	46.00	42.50	56.00	50.00	59.00	60.17	67.52	52.14
13	$N_0P_3K_0$	80.00	60.00	58.30	44.50	38.35	36.00	34.84	36.30	44.00	60.00	68.00	70.00	52.52
14	$N_0P_3K_1$	60.00	65.00	60.00	52.50	46.25	57.50	62.50	60.00	57.50	63.30	66.67	70.00	60.10
15	$N_0P_3K_2$	72.00	60.00	41.41	41.70	40.85	38.30	41.30	46.00	57.00	66.00	65.00	65.00	52.88
16	$N_0P_3K_3$	87.50	91.30	70.00	30.00	23.42	47.00	47.50	60.00	77.50	80.00	62.50	50.00	60.56
17	$N_1P_0K_0$	83.00	90.00	60.38	36.30	52.54	40.00	41.00	39.00	50.00	50.33	56.25	55.00	54.48
18	$N_1P_0K_1$	92.30	56.30	37.50	35.00	30.50	36.70	42.24	66.72	62.00	73.30	83.00	77.00	57.71
19	$N_1P_0K_2$	100.00	92.50	61.48	42.50	35.00	46.70	40.00	50.00	57.50	60.00	70.00	75.00	60.89
20	$N_1P_0K_3$	112.50	57.50	40.00	41.30	38.00	40.00	25.00	31.25	37.00	70.00	94.59	91.67	56.57
21	$N_1P_1K_0$	70.00	80.00	65.00	43.80	37.50	53.80	61.00	62.00	70.00	66.71	70.00	76.67	63.04
22	$N_1P_1K_1$	75.00	83.30	67.50	42.50	34.52	50.00	52.00	37.50	58.00	50.00	62.50	66.67	56.62
23	$N_1P_1K_2$	87.50	82.50	60.00	50.00	37.50	43.00	51.30	52.50	72.57	65.00	95.00	86.25	65.26
24	$N_1P_1K_3$	80.00	93.30	75.00	61.30	60.00	48.00	43.80	35.80	46.54	67.50	60.00	70.00	61.77
25	$N_1P_2K_0$	75.00	62.50	61.70	57.70	48.35	41.70	52.50	45.00	52.00	57.55	60.00	79.00	57.75
26	$N_1P_2K_1$	86.00	80.00	60.58	47.50	36.65	46.00	54.50	55.00	47.50	66.00	60.43	61.00	58.43
27	$N_1P_2K_2$	73.30	62.50	46.70	35.00	39.12	33.80	24.95	43.69	50.00	49.00	59.00	57.00	47.84
28	$N_1P_2K_3$	91.70	50.00	43.30	40.00	45.65	25.00	35.00	43.73	51.67	50.00	54.00	59.00	49.09
29	$N_1P_3K_0$	78.00	80.00	45.00	34.00	51.65	46.70	46.00	48.00	50.00	50.30	60.40	53.00	53.59
30	$N_1P_3K_1$	125.00	118.00	63.30	66.70	58.30	44.00	56.00	67.50	72.00	70.00	67.50	100.00	75.69
31	$N_1P_3K_2$	100.00	80.00	67.50	60.00	29.40	41.30	52.00	50.00	51.00	62.50	53.40	67.50	59.55
32	$N_1P_3K_3$	69.00	60.00	46.00	42.50	38.30	33.00	56.00	69.00	75.00	91.00	70.00	71.25	60.09
33	$N_2P_0K_0$	100.00	45.00	40.00	23.80	30.00	26.00	50.00	44.00	40.60	36.00	60.00	75.00	47.53

(Contd. Appendix LIII)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	87.00	73.00	65.00	58.00	55.00	30.89	58.00	57.00	56.67	68.00	70.00	82.00	63.38
35	$N_2P_0K_2$	80.00	70.00	48.00	42.50	39.00	31.42	29.00	33.00	60.00	66.25	78.75	81.25	54.93
36	$N_2P_0K_3$	72.00	58.00	56.30	45.00	46.00	50.00	56.00	58.00	60.00	62.91	63.00	67.00	57.85
37	$N_2P_1K_0$	104.00	86.12	50.00	46.00	45.00	47.00	47.50	57.50	50.00	53.70	83.33	60.00	60.85
38	$N_2P_1K_1$	120.00	100.00	75.00	62.50	42.50	55.00	56.00	53.75	66.44	60.00	77.50	70.00	69.89
39	$N_2P_1K_2$	112.00	108.00	83.30	62.00	66.79	47.50	70.00	85.75	81.25	75.00	83.33	78.00	79.41
40	$N_2P_1K_3$	60.00	56.30	42.00	34.00	25.00	26.30	40.00	37.50	35.00	48.75	50.64	56.67	42.68
41	$N_2P_2K_0$	90.00	86.30	52.00	40.00	60.00	50.00	46.70	49.00	57.00	72.50	73.34	80.00	63.07
42	$N_2P_2K_1$	82.50	71.00	55.00	42.50	37.50	39.00	35.00	34.00	42.00	44.00	57.50	65.00	50.42
43	$N_2P_2K_2$	108.00	71.00	59.00	49.16	45.00	41.30	38.00	51.70	55.00	66.00	71.00	70.00	60.43
44	$N_2P_2K_3$	80.00	95.00	46.70	45.70	38.50	36.30	37.50	47.50	45.00	60.00	58.75	61.67	54.39
45	$N_2P_3K_0$	99.00	62.00	60.00	52.30	42.50	47.50	53.00	51.50	63.00	70.00	83.33	76.00	63.34
46	$N_2P_3K_1$	100.00	86.00	66.00	60.00	52.00	41.40	53.00	60.00	62.90	73.00	110.00	103.00	72.28
47	$N_2P_3K_2$	72.00	70.00	62.50	47.50	38.30	43.80	47.00	46.00	48.00	62.50	70.00	72.50	58.68
48	$N_2P_3K_3$	85.00	70.00	52.50	45.00	42.50	45.00	47.50	62.50	61.25	64.00	75.00	70.11	60.03
49	$N_3P_0K_0$	90.00	75.00	63.80	56.70	46.65	35.00	37.58	43.42	66.80	60.00	48.00	70.00	57.74
50	$N_3P_0K_1$	85.00	95.00	55.00	53.00	45.30	38.00	41.40	44.50	47.50	62.50	65.63	88.00	60.07
51	$N_3P_0K_2$	80.00	92.00	65.00	60.00	39.60	32.00	37.50	36.44	61.00	60.00	57.50	62.00	56.92
52	$N_3P_0K_3$	102.00	127.50	70.30	62.50	45.00	47.00	37.50	34.67	50.00	69.00	64.59	71.00	65.09
53	$N_3P_1K_0$	83.30	76.70	63.80	52.50	43.30	50.00	45.00	65.00	64.00	60.00	69.00	75.00	62.30
54	$N_3P_1K_1$	84.00	60.00	58.00	55.00	35.00	41.00	40.00	53.13	52.00	62.00	86.60	78.75	58.79
55	$N_3P_1K_2$	75.00	93.79	76.30	45.00	40.65	56.30	63.80	63.75	76.00	80.00	59.42	66.67	66.39
56	$N_3P_1K_3$	81.30	78.80	60.00	45.00	37.50	46.00	35.00	48.00	60.00	80.00	97.50	62.50	60.97
57	$N_3P_2K_0$	70.00	78.80	53.30	44.33	50.00	61.70	51.74	50.00	43.30	44.00	60.00	75.00	56.85
58	$N_3P_2K_1$	90.00	85.00	56.70	43.30	41.25	50.00	60.00	64.00	68.00	74.00	75.18	74.73	65.18
59	$N_3P_2K_2$	68.16	76.30	53.30	48.70	29.15	39.70	41.70	41.67	50.00	53.30	62.00	70.00	52.83
60	$N_3P_2K_3$	110.00	73.30	55.00	45.00	43.37	40.00	36.70	51.67	54.00	60.00	61.00	65.00	57.92
61	$N_3P_3K_0$	89.00	83.64	67.50	52.50	41.65	42.00	48.80	61.00	76.25	80.00	95.00	93.30	69.22
62	$N_3P_3K_1$	90.00	67.50	53.80	50.00	37.00	43.00	41.30	42.25	43.75	49.00	66.67	60.00	53.69
63	$N_3P_3K_2$	100.00	93.80	65.00	45.48	41.65	37.35	42.50	65.00	57.94	87.00	103.00	90.00	69.06
64	$N_3P_3K_3$	92.00	87.00	59.10	58.00	30.73	25.60	54.00	66.25	72.00	90.00	75.00	81.00	65.89
	Mean	84.87	76.35	57.83	47.67	42.37	42.14	45.50	51.25	56.62	63.60	69.61	71.41	59.05
	%CV	17.32	21.77	18.17	21.58	21.40	19.23	21.40	21.23	18.71	19.69	19.10	16.16	11.30

Appendix LIV. Monthly production of latex (cc/tree/tap) in block-2 of site-2 during October 1994 to September 1995.

SL	Treatment	1994			1994									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	70.50	65.00	55.00	50.00	40.00	45.30	38.52	50.00	54.95	65.00	60.75	65.00	55.00
2	$N_0P_0K_1$	67.50	62.00	58.00	47.50	25.70	24.75	39.20	45.00	58.30	74.24	63.33	70.00	52.96
3	$N_0P_0K_2$	64.00	70.00	57.00	43.30	46.32	56.70	47.00	67.00	68.00	70.00	73.00	73.48	61.32
4	$N_0P_0K_3$	76.00	110.00	60.00	40.00	42.50	30.00	48.25	50.00	81.00	80.00	90.00	99.00	67.23
5	$N_0P_1K_0$	62.50	75.00	62.50	30.00	33.39	37.50	56.30	65.00	61.00	60.00	60.67	62.50	55.53
6	$N_0P_1K_1$	72.50	68.00	52.50	32.00	36.70	28.00	50.00	51.25	52.00	70.00	63.40	75.00	54.28
7	$N_0P_1K_2$	76.30	80.00	58.30	51.00	45.00	50.00	54.00	55.00	68.00	63.25	75.00	80.00	62.99
8	$N_0P_1K_3$	83.80	75.00	50.00	30.00	36.70	44.00	58.80	61.67	77.00	70.00	71.00	63.00	60.08
9	$N_0P_2K_0$	73.89	75.00	68.00	44.00	52.50	50.00	45.00	56.25	75.00	70.00	72.00	71.00	62.72
10	$N_0P_2K_1$	87.50	85.00	71.00	35.00	45.00	46.00	32.00	48.00	63.33	58.00	55.33	54.00	56.68
11	$N_0P_2K_2$	78.00	75.00	61.00	60.00	40.00	44.00	37.00	56.96	59.00	61.00	54.00	56.00	56.83
12	$N_0P_2K_3$	68.80	80.00	70.00	45.00	40.00	42.00	45.00	40.00	68.42	72.50	65.00	55.00	57.64
13	$N_0P_3K_0$	74.00	83.00	52.50	40.00	26.70	37.00	35.80	47.00	65.00	62.50	63.88	75.00	55.20
14	$N_0P_3K_1$	79.00	62.12	65.00	52.00	44.42	50.00	33.00	55.00	79.00	77.50	71.00	75.00	61.92
15	$N_0P_3K_2$	81.00	72.00	60.56	40.00	46.70	35.00	32.50	43.30	56.00	60.00	57.50	71.00	54.63
16	$N_0P_3K_3$	85.00	92.50	57.00	50.00	21.70	23.80	45.00	58.00	59.00	64.00	71.00	66.72	57.81
17	$N_1P_0K_0$	75.00	70.00	50.00	43.30	50.00	35.00	45.50	55.77	81.00	67.69	62.50	78.00	59.48
18	$N_1P_0K_1$	80.00	77.32	72.70	39.00	40.00	30.00	25.96	50.00	60.00	85.00	77.50	70.00	58.96
19	$N_1P_0K_2$	77.50	66.60	67.50	52.50	36.70	40.00	48.00	55.00	65.00	77.50	80.00	67.50	61.15
20	$N_1P_0K_3$	70.00	65.00	54.70	31.60	40.00	52.00	48.50	57.00	80.00	72.50	62.50	65.47	58.27
21	$N_1P_1K_0$	81.00	70.00	67.00	68.80	50.00	45.00	54.00	60.00	71.00	77.50	70.00	81.00	66.28
22	$N_1P_1K_1$	85.00	80.00	60.00	35.00	43.80	44.00	38.80	47.50	60.00	71.25	65.00	75.00	58.78
23	$N_1P_1K_2$	98.80	77.00	48.00	45.00	50.00	42.50	42.00	56.67	66.00	66.67	60.00	80.00	61.05
24	$N_1P_1K_3$	82.80	85.00	70.00	50.00	45.00	40.00	53.30	55.00	65.00	67.54	71.00	80.00	63.72
25	$N_1P_2K_0$	71.70	87.50	60.00	45.00	56.70	40.12	43.80	43.00	60.00	57.50	60.00	50.00	56.28
26	$N_1P_2K_1$	95.00	80.00	55.00	43.00	40.00	37.00	46.00	48.00	61.00	62.00	72.00	83.48	60.21
27	$N_1P_2K_2$	68.00	65.00	56.00	50.00	30.80	40.00	35.00	40.00	51.00	61.00	50.00	54.16	50.08
28	$N_1P_2K_3$	68.80	65.00	56.00	52.50	31.30	37.50	36.00	43.00	56.00	58.39	60.71	55.00	51.68
29	$N_1P_3K_0$	76.54	71.00	60.00	50.00	33.30	30.57	35.00	47.00	52.50	47.50	45.00	56.67	50.42
30	$N_1P_3K_1$	107.00	71.50	72.54	65.00	40.96	50.00	58.80	69.00	70.00	76.00	82.00	87.00	70.82
31	$N_1P_3K_2$	77.50	75.00	50.00	35.00	38.80	40.00	43.00	50.00	56.74	63.00	61.00	60.00	54.17
32	$N_1P_3K_3$	95.00	70.00	60.00	50.00	42.00	45.00	40.46	50.00	71.00	67.50	71.00	80.00	61.83
33	$N_2P_0K_0$	58.30	61.00	56.70	45.00	44.00	27.06	40.24	53.00	54.33	56.00	42.00	50.00	48.97

(Contd. Appendix LIV)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	110.00	75.00	65.00	60.00	37.50	30.00	52.50	50.59	97.00	100.00	68.33	75.00	68.41
35	$N_2P_0K_2$	81.70	70.00	60.00	50.00	45.00	40.00	38.25	50.00	70.00	87.50	62.50	60.00	59.58
36	$N_2P_0K_3$	91.70	95.00	70.00	42.00	38.00	40.00	25.12	50.67	66.00	75.00	60.00	50.00	58.62
37	$N_2P_1K_0$	85.00	98.00	90.00	60.00	50.00	42.00	41.00	43.00	62.50	70.00	77.00	87.50	67.17
38	$N_2P_1K_1$	80.00	70.00	65.00	55.00	49.00	34.00	44.00	50.00	70.00	68.00	66.48	72.00	60.29
39	$N_2P_1K_2$	95.00	110.00	80.00	45.00	50.00	52.00	53.00	55.00	68.34	65.00	80.00	87.50	70.07
40	$N_2P_1K_3$	77.50	50.00	23.50	22.50	25.00	26.70	31.30	25.00	40.00	50.00	51.25	48.97	39.31
41	$N_2P_2K_0$	66.70	75.00	61.00	46.00	39.00	35.00	55.00	61.00	76.67	75.00	70.00	78.11	61.54
42	$N_2P_2K_1$	58.30	66.70	55.00	41.00	35.00	24.00	43.00	35.00	41.44	67.00	62.00	58.00	48.87
43	$N_2P_2K_2$	97.00	71.00	57.00	50.00	46.24	40.69	49.00	60.00	71.00	75.00	73.00	70.00	63.33
44	$N_2P_2K_3$	75.00	70.00	57.95	44.00	35.00	40.00	27.00	44.00	62.00	87.00	78.00	71.25	57.60
45	$N_2P_3K_0$	94.00	89.00	70.30	67.00	58.00	45.00	35.00	50.00	67.00	65.00	69.00	91.00	66.69
46	$N_2P_3K_1$	114.00	91.00	85.50	65.00	52.00	41.50	46.50	60.00	65.00	84.00	70.00	81.00	71.29
47	$N_2P_3K_2$	82.50	60.00	50.00	43.00	32.00	41.30	43.91	55.00	42.50	47.50	53.33	75.00	52.17
48	$N_2P_3K_3$	95.00	84.00	73.80	60.00	46.00	50.00	47.00	54.00	70.00	71.25	66.67	72.00	65.81
49	$N_3P_0K_0$	87.00	75.00	66.70	50.00	33.30	35.00	55.40	60.00	88.00	80.00	70.00	72.50	64.41
50	$N_3P_0K_1$	77.00	70.00	53.30	56.00	54.00	46.30	53.65	50.00	95.00	66.67	71.25	67.50	63.39
51	$N_3P_0K_2$	82.50	80.00	63.30	50.00	37.50	46.50	41.25	48.50	75.00	80.00	60.00	75.00	61.63
52	$N_3P_0K_3$	80.11	90.00	68.80	60.00	55.00	50.00	50.75	50.00	84.00	105.00	82.50	75.00	70.93
53	$N_3P_1K_0$	76.00	70.00	62.50	40.96	39.00	37.54	37.50	50.00	67.00	69.00	70.50	75.00	57.92
54	$N_3P_1K_1$	98.00	80.00	72.00	35.00	40.00	50.00	68.00	61.00	80.00	70.00	65.75	72.00	65.98
55	$N_3P_1K_2$	107.00	80.00	76.00	49.00	33.32	56.00	60.00	64.00	70.00	88.00	75.00	98.00	71.36
56	$N_3P_1K_3$	96.00	84.00	67.32	42.00	32.00	50.00	52.00	63.00	65.00	77.00	65.00	70.00	63.61
57	$N_3P_2K_0$	75.50	60.00	53.00	40.00	50.00	51.00	56.00	62.00	82.00	70.00	72.50	78.00	62.50
58	$N_3P_2K_1$	95.00	80.00	56.00	46.00	31.00	48.00	43.70	48.00	62.00	90.00	82.70	70.00	62.70
59	$N_3P_2K_2$	85.00	80.00	52.00	44.00	37.30	42.50	46.00	56.00	66.90	62.50	69.00	75.00	59.68
60	$N_3P_2K_3$	100.00	77.50	65.00	35.00	43.30	42.50	37.00	47.20	73.00	68.00	65.00	66.54	60.00
61	$N_3P_3K_0$	92.00	79.00	71.00	50.00	33.30	48.00	60.80	68.00	79.00	83.00	72.00	75.00	67.59
62	$N_3P_3K_1$	75.00	60.00	50.00	51.00	39.00	35.10	45.00	52.00	60.00	52.50	63.00	72.00	54.55
63	$N_3P_3K_2$	90.00	91.00	60.00	43.00	50.00	52.00	49.00	58.00	80.00	85.00	73.40	72.00	66.95
64	$N_3P_3K_3$	105.00	93.80	62.00	50.00	52.54	55.00	40.00	50.00	57.50	94.31	71.67	93.30	68.76
Mean		82.70	76.43	61.52	46.61	41.17	41.37	44.88	52.51	66.87	71.11	67.28	71.65	60.28
%CV		15.27	15.09	16.23	20.23	19.72	19.85	20.08	15.16	17.14	16.18	13.48	16.14	10.48

Appendix LV. Monthly production of latex (cc/tree/tap) in block -3 of site-2 during October 1994 to Septembers 1995.

SL	Treatment	1994			1995									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	65.00	50.00	37.50	30.00	38.80	46.70	55.00	57.00	59.00	64.00	61.25	66.00	52.52
2	$N_0P_0K_1$	80.00	60.00	50.00	33.30	30.00	40.00	30.00	37.50	52.50	65.00	68.34	65.00	50.97
3	$N_0P_0K_2$	78.80	75.00	65.00	44.30	34.00	40.50	43.30	52.50	55.75	99.00	63.13	74.00	60.44
4	$N_0P_0K_3$	87.55	71.50	61.00	49.50	37.50	45.80	48.50	61.25	73.00	102.00	83.30	82.50	66.95
5	$N_0P_1K_0$	73.30	60.00	53.30	50.00	31.32	43.30	41.70	47.00	51.00	65.00	63.00	71.00	54.16
6	$N_0P_1K_1$	73.07	70.00	47.00	50.00	40.00	45.00	40.00	43.44	43.30	55.00	68.33	60.00	52.93
7	$N_0P_1K_2$	85.00	75.00	65.00	45.00	35.00	40.00	50.00	60.00	63.00	75.00	78.75	62.00	61.15
8	$N_0P_1K_3$	67.50	60.00	57.00	39.00	35.00	37.58	40.36	42.50	59.38	70.00	64.00	66.67	53.25
9	$N_0P_2K_0$	70.00	80.00	65.00	60.00	40.00	57.00	45.50	50.00	55.00	72.00	78.00	70.00	61.88
10	$N_0P_2K_1$	57.50	50.00	43.80	50.00	33.30	40.00	42.48	45.00	42.00	50.00	60.00	75.00	49.09
11	$N_0P_2K_2$	67.00	66.70	46.30	41.00	34.72	37.00	35.00	37.50	60.00	80.00	83.00	53.36	53.47
12	$N_0P_2K_3$	66.00	60.00	65.00	40.00	35.00	44.00	38.00	44.00	52.00	62.50	61.25	65.00	52.73
13	$N_0P_3K_0$	60.00	75.00	80.00	55.00	49.00	55.00	46.90	54.00	49.97	60.00	54.17	71.00	59.17
14	$N_0P_3K_1$	73.00	75.00	66.70	46.90	40.00	42.50	48.75	50.00	66.00	67.00	68.34	61.25	58.79
15	$N_0P_3K_2$	80.00	85.00	53.00	52.00	35.00	41.00	25.90	31.25	38.50	60.00	51.25	54.00	50.58
16	$N_0P_3K_3$	62.00	80.00	70.00	47.50	30.00	37.50	41.25	48.00	54.00	65.00	66.25	65.00	55.54
17	$N_1P_0K_0$	75.00	62.00	53.00	37.00	46.70	45.30	30.00	57.00	61.00	64.00	65.96	73.00	55.83
18	$N_1P_0K_1$	80.67	60.00	57.00	40.50	30.00	38.67	38.00	40.00	54.00	60.00	71.00	66.00	52.99
19	$N_1P_0K_2$	85.00	76.00	60.00	37.50	53.00	52.00	60.00	66.67	71.67	78.66	70.67	65.00	64.68
20	$N_1P_0K_3$	65.00	80.00	65.00	50.00	40.00	55.00	40.00	59.00	60.00	90.00	86.00	80.00	64.17
21	$N_1P_1K_0$	75.00	77.00	63.00	50.00	35.00	47.50	56.00	65.00	62.51	70.00	74.00	76.67	62.64
22	$N_1P_1K_1$	91.00	75.00	55.00	45.00	25.00	52.50	50.00	47.50	52.78	60.00	66.70	65.00	57.12
23	$N_1P_1K_2$	88.00	78.00	62.00	55.00	35.00	36.00	32.00	45.67	53.33	66.25	67.00	60.00	56.52
24	$N_1P_1K_3$	97.50	85.00	71.00	57.50	48.00	52.00	55.00	64.60	65.00	72.00	80.00	70.00	68.13
25	$N_1P_2K_0$	72.00	60.00	59.00	55.00	36.00	47.00	33.68	48.00	51.00	60.00	52.00	67.00	53.39
26	$N_1P_2K_1$	70.00	60.00	50.00	40.00	43.30	45.00	57.25	44.00	46.00	50.00	64.21	57.00	53.23
27	$N_1P_2K_2$	75.00	55.00	50.00	37.50	40.00	27.50	37.50	45.00	46.00	65.00	58.00	61.00	49.79
28	$N_1P_2K_3$	60.00	57.00	55.00	30.00	40.00	34.00	37.50	48.00	51.00	62.50	50.00	55.00	48.33
29	$N_1P_3K_0$	82.00	75.00	80.00	50.00	43.00	30.00	35.52	44.00	47.00	65.00	64.00	69.00	57.04
30	$N_1P_3K_1$	110.00	100.00	60.00	56.70	45.00	55.00	47.40	54.00	61.00	85.00	78.42	77.00	69.13
31	$N_1P_3K_2$	86.30	89.00	80.00	66.70	40.00	50.00	32.50	50.00	53.00	65.00	57.00	60.00	60.79
32	$N_1P_3K_3$	89.00	70.00	62.50	50.00	41.00	46.00	47.15	41.25	51.00	60.00	69.00	56.00	56.91
33	$N_2P_0K_0$	66.70	62.30	41.00	40.00	36.00	30.00	31.00	35.67	35.00	40.00	55.00	50.00	43.56

(Contd. Appendix LV)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	96.00	65.00	60.00	55.00	51.00	60.00	62.00	60.25	65.00	86.55	65.00	71.00	66.40
35	$N_2P_0K_2$	72.00	64.00	50.00	30.00	45.00	35.00	47.50	52.96	55.00	66.00	67.50	70.00	54.58
36	$N_2P_0K_3$	86.00	70.00	57.50	42.50	53.80	37.00	45.00	56.00	58.00	102.00	87.00	76.56	64.28
37	$N_2P_1K_0$	72.00	73.00	68.00	60.00	45.00	43.00	46.00	43.50	55.00	83.66	73.00	70.00	61.01
38	$N_2P_1K_1$	97.00	80.00	63.00	60.00	45.00	54.00	52.50	70.00	74.00	85.00	75.00	80.00	69.63
39	$N_2P_1K_2$	100.00	98.00	72.00	65.00	50.00	56.00	57.50	66.70	73.00	83.57	89.00	85.00	74.65
40	$N_2P_1K_3$	58.00	55.00	52.00	40.00	30.67	44.00	40.00	54.00	55.00	56.67	52.00	56.00	49.45
41	$N_2P_2K_0$	81.00	75.00	69.00	55.00	40.00	52.50	48.35	60.00	55.00	84.00	91.67	96.00	67.29
42	$N_2P_2K_1$	67.55	75.00	50.00	67.50	50.00	49.70	39.00	40.00	43.98	68.00	65.00	67.00	56.89
43	$N_2P_2K_2$	105.00	89.88	60.00	50.00	40.00	58.00	53.15	58.00	61.00	80.00	77.00	82.58	67.88
44	$N_2P_2K_3$	90.00	88.00	70.00	46.00	40.00	56.00	32.29	46.00	50.00	70.00	60.00	80.00	60.69
45	$N_2P_3K_0$	91.00	85.00	77.50	40.00	47.52	50.00	44.40	54.00	60.00	78.75	75.67	80.00	65.32
46	$N_2P_3K_1$	94.00	90.00	77.50	56.00	54.00	44.00	46.50	56.00	48.75	70.00	75.00	65.00	64.73
47	$N_2P_3K_2$	77.62	73.44	55.00	57.50	30.30	31.30	32.90	37.50	44.00	54.00	58.00	88.00	51.63
48	$N_2P_3K_3$	85.00	79.00	50.00	40.00	42.50	50.24	53.25	53.00	55.00	62.50	65.54	71.00	58.92
49	$N_3P_0K_0$	92.00	81.00	60.00	42.00	48.00	36.00	43.00	54.00	56.00	73.30	71.25	62.00	59.88
50	$N_3P_0K_1$	90.00	75.00	65.00	52.10	40.00	50.00	59.00	57.90	64.00	85.00	90.00	77.50	67.13
51	$N_3P_0K_2$	89.00	62.50	50.00	48.50	41.70	37.50	36.92	46.00	65.00	61.75	66.00	81.00	57.16
52	$N_3P_0K_3$	91.00	90.00	77.30	42.50	45.00	54.00	52.00	54.50	52.50	96.00	87.34	80.00	68.51
53	$N_3P_1K_0$	90.00	95.00	80.00	55.00	44.00	52.00	40.00	50.00	63.75	92.00	78.83	67.50	67.34
54	$N_3P_1K_1$	102.00	80.00	75.00	60.00	33.00	36.30	37.75	41.00	55.00	68.75	75.00	65.00	60.73
55	$N_3P_1K_2$	95.00	82.50	87.50	60.00	50.00	56.00	44.00	57.00	79.00	70.00	87.33	70.00	69.86
56	$N_3P_1K_3$	85.00	78.00	59.00	30.00	35.00	42.50	46.70	52.00	62.71	92.00	90.00	75.00	62.33
57	$N_3P_2K_0$	85.00	69.82	68.00	52.00	48.00	35.00	45.85	52.50	68.00	70.00	74.00	73.67	61.82
58	$N_3P_2K_1$	87.00	80.00	68.00	70.00	37.50	45.00	51.26	50.00	45.00	70.00	84.00	80.00	63.98
59	$N_3P_2K_2$	93.00	75.00	60.00	50.00	25.24	37.50	48.55	45.00	53.75	73.00	72.70	70.00	58.65
60	$N_3P_2K_3$	90.00	67.00	50.00	35.00	43.33	38.30	44.35	50.00	58.00	62.50	65.00	75.00	56.54
61	$N_3P_3K_0$	96.70	86.00	65.00	37.50	50.00	58.50	59.80	74.00	90.00	94.00	84.00	95.00	74.21
62	$N_3P_3K_1$	84.00	80.00	60.00	25.00	30.00	40.00	38.15	40.00	65.00	87.50	70.00	97.83	59.79
63	$N_3P_3K_2$	97.00	85.00	60.00	53.30	55.00	58.00	56.55	64.00	74.00	85.25	96.00	87.70	72.65
64	$N_3P_3K_3$	86.00	80.00	57.50	50.00	37.50	47.50	52.50	53.00	56.00	71.00	75.00	84.00	62.50
Mean		82.01	74.24	61.45	47.65	40.53	45.17	44.69	51.17	57.44	72.62	71.10	71.20	59.74
%CV		15.16	15.54	17.09	20.86	17.67	17.73	19.00	17.09	17.00	17.86	15.56	14.91	11.56

Appendix LVI. Monthly production of latex (cc/tree/tap) in block-1 of site-2 during October 1995 to September 1996.

SL	Treatment	1995			1996									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	67.50	62.50	58.00	57.00	30.00	35.00	53.30	56.00	60.67	60.00	61.65	86.73	57.36
2	$N_0P_0K_1$	96.00	80.00	84.00	62.00	41.97	43.66	45.00	52.97	57.00	60.00	87.00	86.00	66.30
3	$N_0P_0K_2$	106.62	105.00	71.00	66.67	43.75	66.67	59.00	60.00	67.50	80.00	76.67	82.60	73.79
4	$N_0P_0K_3$	115.00	112.25	83.34	66.67	50.00	52.28	66.67	60.00	66.67	75.00	109.00	100.00	79.74
5	$N_0P_1K_0$	116.00	96.00	60.00	47.00	50.00	59.00	52.70	53.38	70.00	66.67	75.00	83.30	69.09
6	$N_0P_1K_1$	95.00	79.00	62.50	55.00	50.00	31.25	50.00	52.00	61.00	60.00	67.20	65.00	60.66
7	$N_0P_1K_2$	87.00	86.00	64.00	57.00	35.00	43.96	53.00	60.00	73.69	73.00	99.00	80.80	67.70
8	$N_0P_1K_3$	75.00	78.30	65.00	58.33	45.00	52.50	60.00	61.67	71.00	86.88	88.00	91.00	69.39
9	$N_0P_2K_0$	75.00	78.30	65.00	58.33	45.00	52.50	60.00	61.67	71.00	78.00	88.00	91.00	68.65
10	$N_0P_2K_1$	82.50	72.50	70.00	46.67	35.00	37.00	40.00	55.50	66.67	62.50	87.50	70.00	60.49
11	$N_0P_2K_2$	92.00	84.00	77.49	66.25	50.00	33.60	56.00	58.00	67.00	76.67	80.00	66.67	67.31
12	$N_0P_2K_3$	76.00	86.00	75.00	64.00	36.00	25.00	43.30	50.00	65.94	87.00	88.00	95.00	65.94
13	$N_0P_3K_0$	92.00	72.00	66.00	54.00	52.00	53.00	43.33	75.00	66.67	93.67	87.50	93.95	70.76
14	$N_0P_3K_1$	81.00	84.00	68.00	60.00	57.00	57.53	62.00	66.67	75.00	82.00	83.50	97.00	72.84
15	$N_0P_3K_2$	72.00	62.50	65.00	50.00	51.00	68.67	70.80	70.00	81.00	83.33	79.00	86.68	70.00
16	$N_0P_3K_3$	76.00	70.00	50.00	46.00	36.67	41.25	60.00	56.92	85.00	81.25	90.00	80.50	64.47
17	$N_1P_0K_0$	87.00	66.67	60.00	56.89	58.00	50.00	50.36	53.00	65.00	63.66	80.00	83.33	64.49
18	$N_1P_0K_1$	86.00	66.67	62.50	45.00	39.96	47.50	50.00	60.00	75.00	72.50	83.75	93.75	65.22
19	$N_1P_0K_2$	96.40	86.00	70.00	60.00	47.00	45.00	63.30	77.50	84.00	79.00	87.50	102.50	74.85
20	$N_1P_0K_3$	78.00	80.00	70.00	62.00	36.00	30.00	60.00	65.00	98.00	96.00	100.00	125.00	75.00
21	$N_1P_1K_0$	84.00	91.00	64.00	70.00	43.30	35.00	47.50	66.67	70.97	83.46	90.00	95.00	70.08
22	$N_1P_1K_1$	82.00	68.00	70.00	50.00	40.00	45.00	46.72	65.00	67.00	87.88	88.00	81.43	65.92
23	$N_1P_1K_2$	82.98	80.00	70.00	53.75	50.00	33.30	65.00	73.00	72.85	103.33	90.00	96.00	72.52
24	$N_1P_1K_3$	91.12	74.00	80.00	63.00	43.30	47.50	56.67	61.78	61.00	77.00	85.00	113.00	71.11
25	$N_1P_2K_0$	94.00	80.00	70.67	53.30	65.00	62.50	40.00	50.00	75.00	67.50	72.00	78.67	67.39
26	$N_1P_2K_1$	84.00	119.30	80.00	57.00	50.00	55.00	42.00	60.00	88.00	98.00	115.00	106.75	79.59
27	$N_1P_2K_2$	113.30	96.00	65.00	55.67	35.00	26.67	37.59	46.67	50.00	54.92	68.34	75.00	60.35
28	$N_1P_2K_3$	96.00	73.30	63.34	53.00	50.00	35.00	45.00	52.00	60.00	65.00	81.22	85.00	63.24
29	$N_1P_3K_0$	70.39	91.38	70.00	60.00	43.75	51.67	62.50	55.00	64.00	63.00	80.00	93.30	67.08
30	$N_1P_3K_1$	120.00	102.50	103.00	60.00	51.00	55.00	50.00	80.00	100.00	113.00	103.34	110.00	87.32
31	$N_1P_3K_2$	105.36	98.70	62.00	57.67	50.00	54.67	56.00	63.00	61.50	66.97	73.00	63.63	67.71
32	$N_1P_3K_3$	87.54	67.50	70.00	50.00	55.00	65.00	60.00	63.77	70.00	84.00	106.67	100.00	73.29
33	$N_2P_0K_0$	67.00	60.00	58.00	47.50	41.67	33.33	50.00	60.00	70.00	65.00	85.00	70.00	58.96

(Contd. Appendix LVL)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	103.75	94.00	76.00	75.00	58.33	50.00	60.00	66.67	70.00	89.00	92.00	96.00	77.56
35	$N_2P_0K_2$	96.67	86.00	59.46	53.00	42.30	45.00	68.97	63.30	74.00	73.80	90.50	97.00	70.83
36	$N_2P_0K_3$	90.00	82.00	74.00	66.67	50.00	43.75	60.00	67.50	66.67	80.00	95.00	101.50	73.09
37	$N_2P_1K_0$	87.50	80.00	60.00	55.00	50.00	52.00	40.00	43.85	60.00	63.37	87.50	81.00	63.35
38	$N_2P_1K_1$	93.00	72.00	65.83	66.67	65.00	50.00	68.34	65.00	80.00	100.00	127.00	108.00	80.07
39	$N_2P_1K_2$	135.25	90.00	75.00	71.00	67.50	53.30	77.50	75.00	88.75	100.00	118.75	106.67	88.23
40	$N_2P_1K_3$	85.00	61.00	53.50	35.00	40.00	40.27	46.00	52.00	51.15	68.00	75.00	79.00	57.16
41	$N_2P_2K_0$	100.00	92.00	70.00	66.00	50.00	53.00	55.50	88.00	90.43	83.60	94.00	103.00	78.79
42	$N_2P_2K_1$	59.50	59.70	40.30	30.00	32.00	35.00	40.00	55.00	63.00	70.00	82.50	83.00	54.17
43	$N_2P_2K_2$	94.96	90.00	72.00	56.00	45.00	48.00	49.00	63.75	70.00	85.00	94.00	74.17	70.16
44	$N_2P_2K_3$	75.00	57.00	50.00	47.00	35.00	36.00	40.00	61.00	75.00	81.30	106.67	125.00	65.75
45	$N_2P_3K_0$	87.50	90.00	68.75	65.00	48.00	50.00	55.00	59.00	70.00	79.67	95.00	96.67	72.05
46	$N_2P_3K_1$	90.00	125.00	80.00	43.75	50.00	53.00	55.33	60.00	66.67	62.50	112.50	92.00	74.23
47	$N_2P_3K_2$	108.00	72.50	70.00	57.00	51.96	53.00	56.00	67.67	70.00	80.35	86.00	115.00	73.96
48	$N_2P_3K_3$	93.50	77.00	68.00	63.33	47.67	51.00	59.00	58.98	55.50	80.00	107.34	102.00	71.94
49	$N_3P_0K_0$	82.46	72.50	65.00	55.30	30.00	40.00	50.00	65.00	73.30	83.60	99.00	93.00	67.43
50	$N_3P_0K_1$	97.50	85.00	80.00	62.00	51.00	43.00	53.00	67.56	63.38	99.00	96.00	103.30	75.06
51	$N_3P_0K_2$	86.00	90.00	70.00	62.50	35.00	53.75	53.30	75.00	90.00	81.00	68.00	63.57	69.01
52	$N_3P_0K_3$	96.00	74.00	66.00	50.00	43.30	35.00	56.00	60.00	91.00	96.25	115.76	117.50	75.07
53	$N_3P_1K_0$	93.75	83.00	66.67	62.30	56.67	55.00	53.00	59.00	75.00	72.50	87.50	110.98	72.95
54	$N_3P_1K_1$	84.00	75.00	70.00	60.00	43.33	33.33	50.36	54.00	65.00	112.50	105.00	130.00	73.54
55	$N_3P_1K_2$	125.00	100.00	65.00	50.00	55.00	60.00	43.30	69.00	61.00	80.00	92.50	103.40	75.35
56	$N_3P_1K_3$	80.00	79.00	71.00	60.00	50.00	65.00	66.67	75.00	80.00	111.67	90.00	85.00	76.11
57	$N_3P_2K_0$	75.00	60.00	50.00	45.00	43.30	26.29	50.00	69.67	83.00	82.00	92.67	95.00	64.33
58	$N_3P_2K_1$	103.35	91.00	73.30	66.67	35.00	37.00	66.67	70.00	74.55	85.00	87.00	105.00	74.55
59	$N_3P_2K_2$	72.57	65.00	67.00	53.00	50.00	35.00	43.30	50.00	69.17	95.00	80.00	90.00	64.17
60	$N_3P_2K_3$	90.00	85.00	75.00	55.00	35.00	40.96	52.54	57.50	65.55	62.34	66.00	89.75	64.55
61	$N_3P_3K_0$	115.00	97.50	66.67	60.00	41.25	55.00	62.00	65.00	64.00	98.80	112.50	105.00	78.56
62	$N_3P_3K_1$	116.67	66.67	63.00	50.00	45.00	57.50	64.00	66.00	70.00	75.00	85.00	80.33	69.93
63	$N_3P_3K_2$	112.00	100.00	87.50	62.50	60.00	61.00	62.38	64.00	94.00	107.45	120.00	112.50	86.94
64	$N_3P_3K_3$	105.67	85.00	90.00	55.00	50.00	44.00	48.00	65.00	81.00	95.50	94.97	92.00	75.51
	Mean	91.65	81.97	68.47	56.71	46.31	46.57	54.20	62.04	71.71	80.87	90.50	93.59	70.36
	%CV	16.60	17.63	14.55	14.62	18.32	22.98	16.83	13.73	15.22	18.15	15.27	16.19	9.94

Appendix LVII. Monthly production of latex (cc/tree/tap) in block-2 of site-2 during October 1995 to September 1996.

SL	Treatment	1995			1996									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	83.64	80.00	63.00	61.25	48.00	51.00	50.00	55.00	62.46	68.50	66.67	60.00	62.46
2	$N_0P_0K_1$	76.67	80.00	62.50	57.56	47.00	48.00	52.00	66.00	67.00	76.67	75.00	80.00	65.70
3	$N_0P_0K_2$	125.00	101.00	81.25	63.00	52.31	61.33	66.67	70.00	71.93	66.67	75.00	89.00	76.93
4	$N_0P_0K_3$	95.00	78.00	75.00	63.30	50.00	58.00	61.00	70.00	76.91	75.00	86.67	122.00	75.91
5	$N_0P_1K_0$	87.00	80.00	63.00	54.25	50.00	33.36	57.00	60.00	66.41	73.00	72.00	65.34	63.45
6	$N_0P_1K_1$	80.00	87.00	60.00	50.00	43.30	56.67	62.50	68.00	67.95	65.00	81.00	94.00	67.95
7	$N_0P_1K_2$	93.75	100.00	63.25	64.00	50.00	36.67	55.00	68.00	70.00	73.00	110.00	100.00	73.64
8	$N_0P_1K_3$	90.00	117.50	80.00	66.00	53.55	35.12	73.30	81.00	72.90	70.00	66.67	69.00	72.92
9	$N_0P_2K_0$	80.00	97.83	75.00	60.00	56.00	55.00	58.00	62.50	61.00	79.00	75.67	92.00	71.00
10	$N_0P_2K_1$	90.00	100.00	62.50	53.72	37.50	42.50	55.00	65.00	71.00	66.00	75.00	83.50	66.81
11	$N_0P_2K_2$	105.00	95.00	70.00	62.50	55.00	59.00	58.00	70.34	78.00	70.00	74.00	95.00	74.32
12	$N_0P_2K_3$	98.00	92.00	80.00	65.00	53.20	58.00	63.00	62.00	76.00	75.00	67.00	70.00	71.60
13	$N_0P_3K_0$	80.00	79.00	68.00	61.25	50.00	40.00	47.50	63.30	71.00	90.00	94.45	93.00	69.79
14	$N_0P_3K_1$	92.00	74.00	71.00	70.83	60.00	58.46	66.67	75.00	72.00	79.00	91.00	99.00	75.75
15	$N_0P_3K_2$	97.00	90.00	75.00	69.00	54.00	52.00	65.00	68.52	70.00	69.00	101.00	95.00	75.46
16	$N_0P_3K_3$	88.00	79.00	76.96	62.50	50.00	55.00	50.00	65.00	70.67	76.67	72.00	90.00	69.65
17	$N_1P_0K_0$	75.00	90.00	70.00	56.67	49.00	37.50	51.00	50.00	76.47	65.00	75.00	60.00	62.97
18	$N_1P_0K_1$	115.00	100.00	67.50	58.75	50.00	33.33	55.00	50.00	69.62	67.50	93.75	75.00	69.62
19	$N_1P_0K_2$	80.00	99.00	93.54	62.50	52.00	60.00	66.00	56.50	66.67	73.00	70.67	111.00	74.24
20	$N_1P_0K_3$	81.42	80.00	65.00	58.33	53.30	61.26	65.00	68.75	70.00	76.67	83.33	80.00	70.26
21	$N_1P_1K_0$	75.00	82.00	70.00	62.50	58.00	44.00	63.34	72.00	78.00	73.36	80.82	86.00	70.42
22	$N_1P_1K_1$	98.00	75.00	70.00	58.75	60.00	52.00	50.00	73.30	72.00	80.00	76.67	70.50	69.69
23	$N_1P_1K_2$	90.00	75.00	72.00	57.50	52.60	53.00	59.00	57.00	61.00	70.00	72.00	85.50	67.05
24	$N_1P_1K_3$	85.00	70.00	69.00	67.00	60.00	52.50	47.50	75.00	80.00	84.00	97.00	93.00	73.33
25	$N_1P_2K_0$	79.00	71.00	68.00	64.00	56.05	56.00	55.00	61.00	61.71	67.00	75.00	70.00	65.31
26	$N_1P_2K_1$	90.00	110.00	76.25	50.00	45.00	55.00	62.50	67.00	63.00	70.00	75.00	82.50	70.52
27	$N_1P_2K_2$	80.00	72.50	74.00	65.00	55.00	61.75	65.00	71.00	73.00	60.00	67.00	70.67	67.91
28	$N_1P_2K_3$	108.00	100.00	82.00	65.00	62.50	56.67	37.50	50.00	60.99	75.50	77.00	76.67	70.99
29	$N_1P_3K_0$	70.00	100.00	62.50	40.00	30.00	25.00	50.00	63.30	66.67	53.30	68.75	62.50	57.67
30	$N_1P_3K_1$	112.00	99.00	86.00	60.00	50.00	56.00	58.00	63.00	94.00	92.00	105.00	115.00	82.50
31	$N_1P_3K_2$	70.00	90.00	65.00	47.50	53.00	33.35	60.00	63.00	66.67	75.00	77.50	87.50	65.71
32	$N_1P_3K_3$	95.00	100.00	91.00	65.00	60.00	50.00	58.75	68.75	62.50	68.00	74.50	83.33	73.07
33	$N_2P_0K_0$	76.00	68.00	66.67	52.00	45.00	48.00	55.00	56.67	60.39	60.00	66.95	70.00	60.39

(contd. Appendix LVII.)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	100.00	125.00	90.00	70.00	56.67	60.00	62.00	66.67	81.29	82.50	71.34	110.00	81.29
35	$N_2P_0K_2$	110.00	96.00	94.00	50.00	50.30	56.00	50.00	55.00	68.79	67.34	62.00	66.00	68.79
36	$N_2P_0K_3$	84.00	120.00	76.00	50.00	62.50	40.00	50.00	70.00	74.00	78.16	92.34	116.00	76.08
37	$N_2P_1K_0$	80.00	125.00	75.00	65.00	54.00	58.00	67.00	50.00	60.00	65.00	66.67	75.00	70.06
38	$N_2P_1K_1$	95.00	100.00	80.00	60.00	52.00	50.00	56.00	77.50	69.00	60.00	93.78	76.00	72.44
39	$N_2P_1K_2$	110.50	137.00	87.96	66.25	38.25	48.00	60.00	66.25	82.00	76.64	87.50	102.50	80.24
40	$N_2P_1K_3$	72.50	69.81	61.67	40.00	52.50	50.00	60.00	74.00	61.00	60.00	70.00	86.00	63.12
41	$N_2P_2K_0$	85.00	82.00	70.00	50.00	42.50	45.00	63.30	80.00	86.67	96.00	83.67	92.79	73.08
42	$N_2P_2K_1$	62.50	56.25	52.00	58.33	37.00	46.00	57.00	54.00	58.69	60.67	67.69	70.13	56.69
43	$N_2P_2K_2$	115.00	95.00	72.00	61.98	52.50	50.00	58.00	65.00	85.00	78.00	93.96	95.00	76.79
44	$N_2P_2K_3$	95.00	90.00	85.00	58.50	39.00	35.00	47.50	67.50	91.67	75.00	87.50	70.00	70.14
45	$N_2P_3K_0$	103.00	98.00	72.00	66.25	50.00	66.67	70.00	86.67	97.00	106.67	115.00	110.00	86.77
46	$N_2P_3K_1$	105.00	98.00	80.00	72.00	54.98	68.00	80.00	87.50	95.00	78.00	98.00	101.00	84.79
47	$N_2P_3K_2$	80.00	92.50	59.00	53.00	50.00	51.00	55.00	58.33	56.00	63.31	57.50	86.00	63.47
48	$N_2P_3K_3$	98.00	93.75	77.50	65.00	52.50	58.00	62.50	68.44	93.30	94.00	88.00	90.41	78.45
49	$N_3P_0K_0$	75.00	85.00	65.00	50.00	35.00	47.52	67.00	91.00	89.00	80.00	98.00	87.00	72.46
50	$N_3P_0K_1$	104.00	88.00	75.00	62.50	50.00	52.00	68.00	83.33	85.00	86.67	104.67	112.50	80.97
51	$N_3P_0K_2$	109.00	80.00	72.70	65.00	59.00	67.50	70.00	71.25	80.00	68.50	63.30	75.00	73.44
52	$N_3P_0K_3$	126.87	95.00	70.00	61.00	56.00	35.00	51.17	60.00	75.00	87.00	92.00	105.00	76.17
53	$N_3P_1K_0$	81.46	90.00	69.00	60.00	35.00	47.00	70.00	75.00	84.86	90.00	100.00	96.00	74.86
54	$N_3P_1K_1$	89.00	93.00	100.00	92.50	64.00	70.00	68.96	60.00	68.00	70.00	85.00	88.00	79.04
55	$N_3P_1K_2$	110.00	97.08	94.00	72.00	54.00	56.00	60.00	90.00	93.73	97.00	105.00	100.00	85.73
56	$N_3P_1K_3$	96.00	102.00	100.00	64.00	56.00	59.00	51.67	57.53	61.00	85.00	82.00	81.00	74.60
57	$N_3P_2K_0$	70.00	90.00	61.00	56.00	50.00	57.00	53.00	60.00	64.00	79.00	87.50	76.67	67.01
58	$N_3P_2K_1$	104.00	109.72	77.00	65.00	60.00	53.36	60.00	75.00	80.00	88.00	80.00	75.00	77.26
59	$N_3P_2K_2$	100.00	106.25	75.00	50.00	37.50	33.33	50.00	45.00	75.00	50.00	90.00	85.00	66.42
60	$N_3P_2K_3$	100.00	96.00	75.00	53.38	50.00	67.50	47.50	56.55	68.60	70.00	76.00	74.00	69.54
61	$N_3P_3K_0$	116.67	87.50	80.00	54.00	65.00	66.67	71.68	74.00	71.67	103.00	100.00	120.00	84.18
62	$N_3P_3K_1$	92.00	87.00	61.50	52.50	51.00	50.00	55.96	58.00	60.00	75.50	64.86	70.00	64.86
63	$N_3P_3K_2$	90.00	100.00	71.00	65.00	50.00	57.00	73.75	75.00	90.00	96.00	91.25	95.96	79.58
64	$N_3P_3K_3$	97.00	83.00	80.00	75.00	58.00	61.13	60.00	62.50	72.00	84.00	70.00	83.33	73.83
Mean		92.14	91.87	73.96	60.29	51.20	51.51	59.00	66.51	73.21	75.62	81.93	86.58	71.99
%CV		15.48	16.06	13.88	13.84	14.56	19.71	13.55	15.09	14.24	15.18	16.25	17.84	9.17

Appendix LVIII. Monthly production of latex (cc/tree/tap) in block-3 of site-2 during October 1995 to September 1996.

SL	Treatment	1995			1996									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	80.00	72.00	65.00	60.00	35.00	43.33	66.62	69.00	61.33	71.00	70.00	65.00	63.19
2	$N_0P_0K_1$	80.00	75.00	77.50	75.00	50.00	30.00	54.98	58.00	63.66	80.00	75.00	72.50	65.97
3	$N_0P_0K_2$	69.00	81.00	87.50	65.00	50.00	25.00	33.33	47.50	60.13	78.00	87.50	121.00	67.08
4	$N_0P_0K_3$	95.00	90.00	80.00	62.53	75.00	37.50	57.50	55.00	56.67	70.00	75.00	120.00	72.85
5	$N_0P_1K_0$	118.75	75.00	33.36	50.00	64.00	87.50	66.67	50.00	37.50	50.00	83.00	67.00	65.23
6	$N_0P_1K_1$	75.00	80.00	72.35	58.33	50.00	33.48	37.00	51.50	53.00	55.00	70.00	71.00	58.89
7	$N_0P_1K_2$	120.00	125.00	75.00	62.50	52.00	43.30	52.00	56.00	64.00	66.00	68.75	75.00	71.63
8	$N_0P_1K_3$	90.00	80.00	63.93	53.00	43.00	50.00	62.50	62.00	65.00	67.50	66.67	76.44	65.00
9	$N_0P_2K_0$	100.00	90.00	70.00	60.00	52.53	60.00	62.00	64.67	90.30	77.50	103.00	100.00	77.50
10	$N_0P_2K_1$	80.00	70.00	65.00	52.00	48.00	35.00	45.00	54.00	68.00	72.50	80.00	83.50	62.75
11	$N_0P_2K_2$	100.00	87.50	75.00	62.50	50.00	41.00	54.00	56.00	70.00	66.67	85.56	90.00	69.85
12	$N_0P_2K_3$	90.00	94.36	60.00	61.67	50.00	58.33	59.00	57.00	71.00	69.00	75.00	68.00	67.78
13	$N_0P_3K_0$	92.00	90.00	120.00	80.00	65.00	50.00	40.00	62.50	60.00	72.50	70.00	80.00	73.50
14	$N_0P_3K_1$	89.00	76.00	63.00	62.00	50.00	47.50	60.00	66.67	65.30	78.50	96.25	92.00	70.52
15	$N_0P_3K_2$	90.00	100.00	81.25	70.00	50.00	58.33	31.00	37.50	64.00	68.60	72.50	100.00	68.60
16	$N_0P_3K_3$	96.00	93.30	70.00	67.00	48.00	52.00	54.00	56.67	67.50	65.00	64.25	74.00	67.31
17	$N_1P_0K_0$	80.00	90.00	76.00	62.50	41.00	42.00	56.67	42.50	49.00	59.50	57.28	66.67	60.26
18	$N_1P_0K_1$	87.50	75.00	82.00	55.00	45.00	42.00	53.00	50.00	63.00	67.50	75.00	70.00	63.75
19	$N_1P_0K_2$	105.97	92.00	73.75	70.00	75.00	64.00	36.00	59.50	63.36	75.33	83.33	103.00	75.10
20	$N_1P_0K_3$	100.00	113.00	108.00	77.00	50.00	52.00	62.50	73.30	66.67	87.00	80.00	74.67	78.68
21	$N_1P_1K_0$	97.97	110.00	62.50	56.25	50.00	51.00	53.00	55.00	74.00	70.00	81.00	71.00	69.31
22	$N_1P_1K_1$	90.00	128.00	85.00	57.50	55.00	50.00	53.75	59.50	67.50	63.30	73.60	100.00	73.60
23	$N_1P_1K_2$	102.00	90.00	70.00	56.71	53.67	35.00	36.00	45.00	43.00	58.30	69.00	78.00	61.39
24	$N_1P_1K_3$	100.00	107.34	66.67	66.00	63.00	40.00	59.00	63.30	70.00	90.00	101.15	98.50	77.08
25	$N_1P_2K_0$	90.00	100.00	67.00	54.00	50.00	56.00	53.00	74.60	67.00	66.00	74.00	83.00	69.55
26	$N_1P_2K_1$	85.00	83.33	62.00	45.00	38.67	52.00	56.00	54.67	59.00	71.67	66.00	90.00	63.61
27	$N_1P_2K_2$	87.50	85.00	71.00	60.00	38.75	40.99	31.75	43.50	62.50	78.30	80.00	90.00	64.11
28	$N_1P_2K_3$	90.00	94.00	70.00	60.00	35.00	40.00	50.00	62.50	67.50	74.00	85.00	94.71	68.56
29	$N_1P_3K_0$	70.00	92.96	80.00	59.00	50.00	48.75	30.00	58.00	62.61	61.00	69.00	70.00	62.61
30	$N_1P_3K_1$	120.00	90.00	70.00	77.50	65.00	63.30	65.00	60.00	77.31	76.25	86.67	76.67	77.31
31	$N_1P_3K_2$	99.00	90.00	80.00	50.00	51.00	57.00	63.00	70.00	73.30	76.00	74.00	71.55	71.24
32	$N_1P_3K_3$	86.00	80.00	60.00	53.00	45.00	43.00	53.67	73.30	67.73	66.67	70.00	90.00	65.70
33	$N_2P_0K_0$	80.00	82.00	64.67	50.00	48.50	37.50	58.37	45.00	55.00	59.00	61.00	70.00	59.25

(Contd. Appendix LVIII.)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	120.00	110.00	125.00	62.50	55.00	41.25	65.00	70.00	82.88	96.67	88.30	102.00	84.88
35	$N_2P_0K_2$	73.54	70.00	68.00	50.00	59.50	63.30	60.00	62.50	66.29	66.50	63.30	92.50	66.29
36	$N_2P_0K_3$	118.67	88.98	92.50	58.33	48.00	43.75	62.50	68.00	76.67	65.00	70.00	80.00	72.70
37	$N_2P_1K_0$	78.00	80.00	65.00	50.00	65.00	66.67	59.89	86.67	70.00	83.33	90.00	77.00	72.63
38	$N_2P_1K_1$	110.00	130.00	75.00	70.00	66.25	75.00	80.00	67.50	85.00	83.00	87.83	110.00	86.63
39	$N_2P_1K_2$	120.00	118.00	80.57	67.50	60.00	73.30	70.00	75.00	76.67	89.00	100.00	113.00	86.92
40	$N_2P_1K_3$	70.00	68.00	62.55	66.26	56.67	50.00	40.00	53.00	60.50	60.00	61.50	66.00	59.54
41	$N_2P_2K_0$	115.36	103.00	80.00	72.00	35.00	64.00	71.00	75.00	84.50	108.00	94.70	110.00	84.38
42	$N_2P_2K_1$	80.00	71.00	62.00	54.00	43.00	50.00	41.25	53.30	64.54	64.50	70.19	66.67	60.04
43	$N_2P_2K_2$	89.00	110.00	90.00	60.74	53.30	45.00	66.67	62.50	63.30	75.00	87.50	93.30	74.69
44	$N_2P_2K_3$	112.00	114.65	69.00	57.00	35.00	40.00	46.67	56.00	64.00	75.00	76.70	69.50	67.96
45	$N_2P_3K_0$	84.16	87.53	79.00	75.00	50.84	46.67	62.00	75.00	84.00	77.25	95.67	110.00	77.26
46	$N_2P_3K_1$	93.00	85.00	70.00	63.50	57.50	43.75	75.00	76.67	91.67	91.00	100.00	105.00	79.34
47	$N_2P_3K_2$	92.00	80.00	62.50	58.30	45.00	50.99	56.00	63.30	72.50	69.65	92.50	93.00	69.65
48	$N_2P_3K_3$	90.00	75.00	87.50	62.50	50.00	60.00	63.30	67.50	77.00	78.00	84.76	97.00	74.38
49	$N_3P_0K_0$	70.00	97.00	75.00	53.00	47.00	60.00	50.00	63.00	65.00	68.15	79.17	90.00	68.11
50	$N_3P_0K_1$	90.00	105.00	90.00	66.25	47.50	60.00	76.67	82.50	84.36	101.67	95.33	113.00	84.36
51	$N_3P_0K_2$	82.00	75.00	62.33	58.00	66.67	41.00	52.00	53.30	66.28	62.56	87.50	86.00	66.06
52	$N_3P_0K_3$	110.00	114.00	91.00	65.00	46.67	40.00	60.00	65.00	60.00	67.50	84.00	86.00	74.10
53	$N_3P_1K_0$	84.00	96.00	80.00	76.25	58.00	61.00	75.00	81.34	78.16	80.00	79.21	100.00	79.08
54	$N_3P_1K_1$	87.50	108.00	65.98	58.75	50.00	37.50	50.00	56.67	69.40	79.00	80.00	90.00	69.40
55	$N_3P_1K_2$	93.75	110.00	60.00	66.67	53.30	63.60	73.00	77.50	80.50	85.00	105.00	94.80	80.26
56	$N_3P_1K_3$	100.00	115.00	70.00	65.00	56.67	35.00	50.00	66.67	72.73	70.00	66.67	105.00	72.73
57	$N_3P_2K_0$	88.00	91.00	73.30	60.75	50.00	56.50	59.68	65.00	60.00	62.00	77.50	70.00	67.81
58	$N_3P_2K_1$	87.50	115.00	91.00	60.00	37.50	50.00	60.00	66.67	62.50	91.00	84.80	93.07	74.92
59	$N_3P_2K_2$	99.50	98.00	70.00	66.60	50.00	30.00	56.67	55.00	80.96	87.00	77.83	83.30	71.24
60	$N_3P_2K_3$	75.00	70.00	60.00	50.00	35.00	50.00	48.00	60.00	63.00	71.90	77.50	95.00	62.95
61	$N_3P_3K_0$	120.00	70.00	75.00	68.00	66.98	63.30	82.50	79.00	107.00	113.30	95.80	100.00	86.74
62	$N_3P_3K_1$	75.00	70.00	68.00	56.67	39.75	41.00	40.00	55.00	64.17	66.67	83.00	78.50	61.48
63	$N_3P_3K_2$	130.00	110.00	100.00	80.00	60.00	71.96	78.00	77.00	91.00	87.00	108.00	112.00	92.08
64	$N_3P_3K_3$	100.00	80.00	77.50	66.67	50.00	41.67	69.26	71.67	85.00	79.00	89.00	84.00	74.48
Mean		93.70	92.81	74.92	61.82	51.27	49.73	56.35	62.20	68.99	71.12	80.65	87.79	71.23
%CV		16.28	18.11	19.22	13.03	18.30	24.48	22.08	17.01	17.03	10.91	14.62	17.24	10.90

Appendix LIX. Monthly production of latex (cc/tree/tap) in block-1 of site-3 during October 1994 to September 1995.

SL	Treatment	1994			1995									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	60.00	55.00	50.00	45.00	30.00	32.00	37.00	40.00	65.00	57.50	51.00	59.00	48.46
2	$N_0P_0K_1$	80.00	87.54	60.50	52.00	33.00	38.00	43.59	41.75	45.00	53.00	59.00	70.50	55.32
3	$N_0P_0K_2$	75.00	68.60	55.00	40.00	32.50	30.00	35.00	47.50	40.00	42.00	70.00	65.00	50.05
4	$N_0P_0K_3$	70.00	57.50	55.00	45.00	43.35	38.00	49.00	53.00	58.00	52.00	66.83	68.50	54.68
5	$N_0P_1K_0$	95.00	75.00	68.80	50.00	45.00	50.00	52.00	60.00	63.00	70.00	60.00	72.00	63.40
6	$N_0P_1K_1$	104.96	77.50	80.00	60.00	53.00	31.00	63.00	60.00	58.00	70.00	72.00	80.00	67.46
7	$N_0P_1K_2$	100.00	62.50	60.00	45.00	30.00	55.00	58.00	62.00	65.00	70.00	75.00	73.96	63.04
8	$N_0P_1K_3$	88.80	87.50	67.50	43.30	30.00	45.00	50.00	52.00	53.00	52.00	60.00	70.86	58.33
9	$N_0P_2K_0$	80.00	95.00	60.00	50.00	36.00	45.00	50.00	60.00	65.00	70.00	91.20	64.00	63.85
10	$N_0P_2K_1$	60.00	50.00	34.00	40.00	28.00	30.96	36.00	42.00	58.75	65.00	60.00	63.33	47.34
11	$N_0P_2K_2$	115.00	108.00	100.00	60.00	62.60	57.50	43.57	43.75	50.00	55.00	66.67	70.00	69.34
12	$N_0P_2K_3$	110.00	92.00	80.00	74.38	65.00	40.00	43.43	55.00	60.00	62.00	73.00	79.67	69.54
13	$N_0P_3K_0$	100.00	72.50	45.00	46.00	42.30	41.00	32.50	45.00	65.00	71.00	70.96	68.00	58.27
14	$N_0P_3K_1$	76.40	75.00	56.30	43.60	38.80	21.00	33.00	35.00	50.00	55.00	52.50	60.00	49.72
15	$N_0P_3K_2$	82.00	60.00	58.00	30.00	37.00	43.00	36.25	38.00	80.00	89.00	91.00	70.00	59.52
16	$N_0P_3K_3$	62.50	60.30	42.00	33.30	25.00	34.00	35.00	42.00	61.00	60.00	70.00	88.00	51.09
17	$N_1P_0K_0$	103.00	105.00	60.00	62.50	39.15	42.00	62.00	74.00	85.00	80.00	98.00	70.00	73.39
18	$N_1P_0K_1$	78.00	57.00	47.50	46.00	41.65	31.00	35.00	45.00	50.00	57.00	67.97	65.00	51.76
19	$N_1P_0K_2$	80.00	62.50	55.00	50.00	42.08	40.50	46.80	51.00	60.60	65.00	70.50	60.50	57.04
20	$N_1P_0K_3$	75.00	67.50	61.52	40.48	41.00	49.00	48.75	50.00	47.00	58.00	60.00	58.00	54.69
21	$N_1P_1K_0$	110.00	65.00	62.50	60.00	53.50	60.50	64.50	58.75	60.00	70.00	62.50	75.00	66.85
22	$N_1P_1K_1$	86.42	83.00	70.00	62.30	46.00	55.00	42.60	50.00	57.00	60.00	78.00	60.00	62.53
23	$N_1P_1K_2$	100.00	62.50	75.00	50.00	32.75	55.00	44.00	46.00	62.50	52.00	48.00	42.50	55.85
24	$N_1P_1K_3$	80.00	78.00	70.00	50.00	38.25	31.30	35.00	48.00	52.50	60.00	53.75	65.00	55.15
25	$N_1P_2K_0$	77.00	62.00	47.00	49.00	37.50	43.12	44.50	48.00	51.00	57.00	60.00	70.00	53.84
26	$N_1P_2K_1$	96.00	72.50	65.00	60.00	45.00	49.00	52.00	62.00	60.00	62.00	80.00	84.00	65.63
27	$N_1P_2K_2$	95.00	90.50	60.00	50.00	30.00	37.50	33.57	30.00	65.00	70.00	80.00	70.00	59.30
28	$N_1P_2K_3$	80.00	77.50	60.00	50.00	45.00	46.30	41.00	50.00	55.00	67.00	69.00	75.00	59.65
29	$N_1P_3K_0$	50.00	57.50	45.00	40.00	35.00	24.00	40.00	32.50	50.00	53.00	72.00	56.00	46.25
30	$N_1P_3K_1$	90.00	59.00	60.00	43.80	46.30	25.00	22.96	40.00	43.00	72.00	82.50	80.00	55.38
31	$N_1P_3K_2$	92.00	77.50	60.00	56.00	48.00	36.00	24.00	35.00	55.00	80.00	79.00	76.00	59.88
32	$N_1P_3K_3$	80.00	65.60	62.50	50.00	53.80	38.80	28.00	45.00	58.75	60.00	87.50	70.00	58.33
33	$N_2P_0K_0$	78.00	65.00	55.00	34.00	38.75	33.00	32.00	47.00	55.00	63.00	65.50	64.50	52.56

(Contd. Appendix LIX.)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	90.00	85.50	68.80	65.00	37.50	50.50	34.50	35.08	52.00	52.50	65.00	69.00	58.78
35	$N_2P_0K_2$	78.50	75.50	58.80	51.80	40.75	42.00	45.60	49.00	60.00	66.50	65.00	64.40	58.15
36	$N_2P_0K_3$	83.00	75.50	72.00	44.00	35.00	42.00	40.00	43.00	45.00	51.00	55.00	58.46	53.66
37	$N_2P_1K_0$	87.00	67.50	60.00	52.00	38.00	45.52	48.00	55.00	70.00	77.50	70.00	82.00	62.71
38	$N_2P_1K_1$	68.80	72.50	70.00	51.00	40.00	47.50	56.25	55.00	60.00	72.00	68.00	79.00	61.67
39	$N_2P_1K_2$	89.00	67.50	60.00	52.00	38.00	36.00	46.00	50.00	60.00	69.00	87.50	77.00	61.00
40	$N_2P_1K_3$	64.00	50.00	45.00	40.00	38.00	35.00	40.00	42.00	55.00	52.00	46.25	48.00	46.27
41	$N_2P_2K_0$	108.00	72.50	65.00	50.00	35.35	44.00	56.66	61.25	60.00	80.00	90.00	96.00	68.23
42	$N_2P_2K_1$	106.00	82.00	52.00	40.00	28.00	36.30	47.50	57.00	55.00	70.00	87.50	90.00	62.61
43	$N_2P_2K_2$	110.00	95.00	75.00	50.00	35.00	36.00	42.00	51.25	68.75	73.00	72.00	70.00	64.83
44	$N_2P_2K_3$	120.00	85.00	63.80	55.00	45.00	33.00	50.00	55.00	60.00	70.00	78.00	88.00	66.90
45	$N_2P_3K_0$	62.50	54.00	50.00	40.00	46.00	44.00	42.00	52.00	53.33	60.00	56.00	60.00	51.65
46	$N_2P_3K_1$	81.30	47.50	45.50	40.00	33.80	42.54	42.50	41.25	50.77	55.00	60.00	62.00	56.18
47	$N_2P_3K_2$	65.00	53.80	55.00	44.00	33.00	23.00	30.00	35.00	50.00	55.00	61.00	66.00	47.57
48	$N_2P_3K_3$	80.00	68.00	50.00	25.00	42.30	24.00	22.00	54.00	60.00	61.00	62.00	47.00	49.36
49	$N_3P_0K_0$	76.00	70.00	61.00	50.00	40.00	42.50	47.00	50.36	59.60	60.00	63.00	68.00	57.29
50	$N_3P_0K_1$	80.00	75.00	65.00	45.00	48.00	36.12	46.00	56.50	69.50	70.00	60.50	66.00	59.80
51	$N_3P_0K_2$	90.00	77.50	55.00	40.00	42.00	32.00	36.00	51.00	59.00	66.00	74.00	75.00	58.13
52	$N_3P_0K_3$	70.96	57.00	53.30	40.00	42.50	43.00	49.00	47.00	60.00	65.00	61.00	64.00	54.40
53	$N_3P_1K_0$	58.00	54.30	53.33	40.84	32.50	36.70	41.66	47.00	58.00	60.00	66.87	60.00	50.77
54	$N_3P_1K_1$	93.80	75.00	53.00	42.30	25.00	42.00	48.00	53.00	59.00	87.50	90.00	76.00	62.05
55	$N_3P_1K_2$	87.50	65.00	50.00	45.00	50.00	53.00	47.00	57.00	56.00	70.00	75.00	64.00	59.96
56	$N_3P_1K_3$	92.00	80.00	68.00	60.00	46.00	35.00	42.00	56.00	72.00	70.00	80.00	64.00	63.75
57	$N_3P_2K_0$	76.00	71.90	60.00	45.00	25.00	35.00	36.00	48.75	56.25	70.00	79.00	71.00	58.16
58	$N_3P_2K_1$	90.00	80.00	77.50	51.30	37.50	40.48	48.75	56.25	65.00	67.00	63.33	65.00	61.84
59	$N_3P_2K_2$	80.00	59.40	45.00	49.00	25.00	36.30	44.00	51.00	50.00	66.67	75.00	67.50	54.07
60	$N_3P_2K_3$	110.00	92.00	80.00	73.30	65.00	40.00	34.00	55.00	60.00	62.00	63.00	59.67	66.16
61	$N_3P_3K_0$	80.00	60.00	45.00	40.00	41.00	25.00	34.00	46.00	56.00	58.00	60.00	61.00	50.50
62	$N_3P_3K_1$	115.00	110.00	55.00	30.00	36.00	24.00	30.00	25.00	60.00	70.00	62.50	50.00	55.63
63	$N_3P_3K_2$	65.00	70.00	63.00	55.00	40.00	38.00	39.25	55.00	54.00	62.00	65.00	66.71	56.08
64	$N_3P_3K_3$	100.00	58.00	50.00	36.00	35.00	33.00	39.00	43.96	60.00	62.00	80.00	64.00	55.08
Mean		85.49	71.80	59.58	47.72	39.71	39.10	42.33	48.84	58.19	64.22	69.45	67.84	57.84
%CV		18.50	19.82	18.84	19.95	22.22	22.66	21.60	18.02	13.48	14.14	16.49	14.83	10.97

Appendix LX. Monthly production of latex (cc/tree/tap) in block-2 of site-3 during October 1994 to September 1995.

SL	Treatment	1994			1995									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	95.00	65.00	45.00	30.00	40.00	38.00	40.00	56.81	77.50	71.25	72.00	73.00	58.63
2	$N_0P_0K_1$	92.00	70.00	50.00	35.00	25.00	19.00	26.00	42.50	53.75	51.00	67.00	75.00	50.52
3	$N_0P_0K_2$	83.00	67.00	55.00	42.00	38.00	40.00	35.00	60.00	65.00	78.00	73.30	82.00	59.86
4	$N_0P_0K_3$	74.00	65.00	50.00	45.00	50.00	41.00	51.00	51.00	55.00	57.00	70.00	76.66	57.31
5	$N_0P_1K_0$	105.00	80.00	58.00	50.00	47.00	37.00	38.00	53.00	64.00	72.00	78.00	90.00	64.33
6	$N_0P_1K_1$	98.00	75.00	52.00	50.00	53.00	42.00	20.00	34.00	50.00	81.00	75.00	100.00	60.83
7	$N_0P_1K_2$	95.00	64.00	56.00	45.00	40.00	38.00	38.33	44.00	50.00	62.00	70.00	95.00	58.11
8	$N_0P_1K_3$	80.00	63.97	63.00	60.00	36.00	35.00	49.46	55.00	63.75	80.00	83.50	82.50	62.68
9	$N_0P_2K_0$	112.00	110.00	70.00	60.00	62.50	45.00	40.00	42.00	58.00	70.00	75.00	110.00	71.21
10	$N_0P_2K_1$	62.00	55.00	50.00	40.00	41.00	22.00	37.50	32.00	40.00	37.00	50.00	33.00	41.63
11	$N_0P_2K_2$	76.70	80.00	65.00	54.00	50.00	30.00	38.30	40.00	51.25	65.00	70.00	75.00	57.94
12	$N_0P_2K_3$	80.00	70.00	55.00	40.00	37.50	41.30	40.00	48.75	57.50	65.00	86.67	108.00	60.81
13	$N_0P_3K_0$	78.00	72.00	60.00	40.00	44.15	30.00	25.00	30.00	45.00	50.00	81.25	85.00	53.37
14	$N_0P_3K_1$	96.00	80.00	55.00	30.00	39.40	25.00	29.50	60.00	58.00	60.00	90.00	100.00	60.24
15	$N_0P_3K_2$	75.00	70.00	54.00	46.00	40.00	20.00	38.75	40.00	45.00	60.00	72.00	88.00	54.06
16	$N_0P_3K_3$	75.00	62.50	51.30	48.00	50.00	30.00	35.00	39.00	60.00	63.00	71.67	100.00	57.12
17	$N_1P_0K_0$	110.00	68.80	47.50	40.00	58.30	32.00	40.00	41.25	50.00	70.00	80.00	95.00	61.07
18	$N_1P_0K_1$	80.00	53.00	47.00	40.00	21.30	30.00	35.00	40.00	47.50	62.50	75.00	100.00	52.61
19	$N_1P_0K_2$	102.00	75.00	60.00	50.00	30.00	25.00	36.66	49.00	50.00	55.00	60.00	65.00	54.81
20	$N_1P_0K_3$	75.00	65.00	55.00	52.00	53.00	32.00	30.00	32.00	50.00	65.00	70.00	80.00	54.92
21	$N_1P_1K_0$	107.00	91.30	62.50	50.00	45.00	30.45	43.33	55.00	61.23	80.00	85.00	85.00	66.32
22	$N_1P_1K_1$	99.00	78.00	70.00	68.00	60.00	30.00	36.66	40.00	68.00	61.00	83.50	85.00	64.93
23	$N_1P_1K_2$	99.00	70.00	60.00	40.00	37.54	36.00	34.00	36.67	57.67	51.67	77.50	75.00	56.25
24	$N_1P_1K_3$	82.00	75.00	60.00	52.00	50.00	35.00	40.00	45.00	67.50	80.00	75.00	88.00	62.46
25	$N_1P_2K_0$	62.00	65.00	50.00	34.00	42.75	30.00	40.00	31.00	44.00	45.00	51.00	49.00	45.31
26	$N_1P_2K_1$	85.00	95.00	65.00	40.00	47.50	40.00	46.00	50.00	58.00	57.00	92.50	112.00	65.67
27	$N_1P_2K_2$	80.00	88.00	55.00	50.00	40.65	30.00	35.00	45.00	62.00	60.00	75.00	80.00	58.39
28	$N_1P_2K_3$	60.00	70.00	52.00	44.00	48.50	38.00	44.00	41.25	68.00	70.00	66.00	70.45	56.02
29	$N_1P_3K_0$	80.00	85.40	55.00	44.00	32.50	36.00	40.00	45.60	60.00	65.00	60.00	70.00	56.13
30	$N_1P_3K_1$	80.00	105.00	65.00	45.00	32.55	30.00	40.00	56.00	55.00	59.00	60.00	64.00	57.63
31	$N_1P_3K_2$	62.50	75.00	56.30	40.00	44.00	35.00	25.00	43.75	52.00	48.00	62.50	71.50	51.30
32	$N_1P_3K_3$	70.00	75.00	61.00	44.00	39.40	41.30	45.00	46.00	50.50	50.66	62.50	66.00	54.28
33	$N_2P_0K_0$	76.00	64.00	53.00	52.00	46.00	45.00	56.00	65.00	62.00	70.00	69.00	75.00	61.08

(Contd. Appendix LX.)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	90.00	87.00	57.00	50.00	55.00	45.00	50.00	45.00	55.00	56.00	77.58	75.00	61.88
35	$N_2P_0K_2$	130.00	81.00	60.00	35.00	37.00	43.80	35.00	65.00	77.50	74.54	87.00	83.00	67.40
36	$N_2P_0K_3$	110.00	85.00	50.00	45.00	40.00	35.00	50.00	87.50	96.25	85.00	100.00	90.00	72.81
37	$N_2P_1K_0$	110.00	100.00	68.00	60.00	52.00	30.00	34.00	65.00	75.00	83.82	83.00	92.00	71.07
38	$N_2P_1K_1$	96.00	85.00	60.00	50.00	40.00	33.00	32.00	40.00	67.50	67.00	87.50	93.00	62.58
39	$N_2P_1K_2$	85.52	78.00	47.12	30.00	35.00	39.17	30.00	53.10	65.00	75.00	80.00	84.00	58.49
40	$N_2P_1K_3$	80.00	60.00	40.00	41.00	37.00	25.00	23.00	27.00	45.00	60.00	70.00	62.50	47.54
41	$N_2P_2K_0$	124.00	100.00	68.00	59.00	51.65	55.00	60.00	67.50	72.50	89.00	105.00	98.75	79.20
42	$N_2P_2K_1$	90.00	72.00	58.00	64.00	34.00	55.00	40.00	57.21	62.00	65.00	75.00	82.00	62.85
43	$N_2P_2K_2$	88.00	80.00	60.00	56.00	51.58	40.00	42.00	45.00	65.00	60.00	75.00	80.00	61.88
44	$N_2P_2K_3$	120.00	106.30	64.00	50.00	42.50	31.30	40.00	45.00	60.00	68.00	75.00	76.20	64.86
45	$N_2P_3K_0$	82.00	73.00	48.00	43.00	40.00	46.00	47.00	45.00	57.88	70.00	73.00	116.67	61.80
46	$N_2P_3K_1$	68.00	60.00	46.00	45.00	50.00	40.00	30.00	37.50	53.75	55.00	61.71	75.00	51.83
47	$N_2P_3K_2$	89.00	85.00	65.00	49.00	39.00	30.00	30.00	32.00	53.00	60.00	62.00	65.00	54.92
48	$N_2P_3K_3$	68.00	65.00	40.00	38.80	40.00	37.50	45.00	48.75	57.50	57.00	61.67	66.75	52.16
49	$N_3P_0K_0$	101.00	78.00	65.00	60.00	55.00	26.00	37.50	41.67	50.00	70.00	85.00	75.00	62.01
50	$N_3P_0K_1$	104.00	95.00	80.00	56.00	50.00	30.00	28.00	65.00	61.00	73.00	69.00	72.00	65.25
51	$N_3P_0K_2$	105.00	85.00	70.00	60.00	50.00	56.00	50.00	55.00	60.00	70.00	85.00	80.00	68.83
52	$N_3P_0K_3$	112.50	70.00	55.00	50.00	40.00	36.00	35.00	37.54	35.00	85.00	95.00	110.00	63.42
53	$N_3P_1K_0$	84.00	65.00	60.00	51.00	50.00	34.00	40.00	50.00	54.52	65.00	68.00	59.96	56.79
54	$N_3P_1K_1$	106.00	75.00	55.00	56.00	50.00	25.00	27.00	38.00	52.00	60.00	97.00	105.00	62.17
55	$N_3P_1K_2$	56.00	50.00	56.67	50.00	25.00	42.50	48.75	42.50	57.50	60.00	66.00	64.00	51.58
56	$N_3P_1K_3$	82.00	90.00	60.00	50.00	25.00	26.30	30.50	30.00	45.00	55.00	60.00	74.00	52.32
57	$N_3P_2K_0$	60.00	64.00	50.00	48.00	30.80	38.00	43.00	42.00	44.00	54.00	55.00	61.00	49.15
58	$N_3P_2K_1$	69.00	85.00	65.00	47.50	53.75	35.00	40.00	43.00	47.00	60.00	80.00	81.00	58.85
59	$N_3P_2K_2$	80.00	60.00	50.00	45.00	35.00	32.00	38.00	45.00	55.00	70.00	65.00	61.00	53.00
60	$N_3P_2K_3$	85.00	75.00	50.00	49.00	52.50	30.00	40.00	50.00	65.00	75.00	80.00	76.00	60.63
61	$N_3P_3K_0$	90.50	85.00	50.00	40.00	35.00	31.30	40.00	38.75	60.00	75.00	80.00	85.50	59.25
62	$N_3P_3K_1$	105.00	90.00	60.00	50.00	42.50	36.30	45.00	40.00	43.75	40.00	63.00	62.00	56.46
63	$N_3P_3K_2$	80.00	75.00	55.00	44.00	34.00	23.00	27.00	44.00	53.00	50.00	60.00	72.00	51.42
64	$N_3P_3K_3$	70.00	60.00	42.00	46.00	43.50	39.00	32.50	37.50	47.50	57.00	60.17	68.15	50.23
Mean		87.61	76.07	56.54	47.16	42.80	34.93	38.11	46.27	57.20	64.48	74.09	80.62	58.76
%CV		19.13	17.32	13.91	17.29	20.84	22.46	20.97	23.84	17.93	17.14	15.73	19.71	11.47

Appendix LXI. Monthly production of latex (cc/tree/tap) in block-3 of site-3 during October 1994 to September 1995.

SL	Treatment	1994			1995									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	65.00	60.00	46.00	38.00	28.00	26.50	40.00	47.50	50.50	70.00	82.50	77.00	52.58
2	$N_0P_0K_1$	67.50	75.00	52.00	47.50	40.00	26.30	42.50	47.98	50.00	60.00	66.25	70.00	53.75
3	$N_0P_0K_2$	70.00	65.00	50.00	45.00	30.00	32.52	41.00	50.00	55.00	75.00	70.30	78.00	55.15
4	$N_0P_0K_3$	67.50	62.00	46.00	40.00	26.70	29.00	36.00	48.00	59.00	83.33	100.00	81.00	56.54
5	$N_0P_1K_0$	68.00	62.50	48.80	45.00	46.00	34.00	47.00	50.00	52.00	67.00	65.00	66.70	52.33
6	$N_0P_1K_1$	65.00	62.00	55.00	51.50	53.00	46.00	57.00	68.70	87.50	80.00	60.00	75.00	63.39
7	$N_0P_1K_2$	60.00	52.50	47.50	42.50	30.00	32.35	40.00	47.60	62.50	66.67	74.00	76.00	52.64
8	$N_0P_1K_3$	74.00	76.00	61.00	62.00	33.00	53.00	60.00	70.00	65.00	84.00	82.00	87.50	67.29
9	$N_0P_2K_0$	76.00	60.00	45.00	35.00	22.50	38.80	40.00	48.00	65.00	61.00	71.00	75.00	53.11
10	$N_0P_2K_1$	77.00	60.50	50.00	52.50	37.50	24.00	31.50	45.00	67.50	67.60	80.00	91.00	57.01
11	$N_0P_2K_2$	89.00	70.00	65.00	50.00	40.00	17.50	40.00	60.00	61.25	70.00	80.00	86.00	60.73
12	$N_0P_2K_3$	71.00	57.00	49.50	45.00	41.00	32.00	35.00	57.50	75.00	70.00	105.00	81.25	59.94
13	$N_0P_3K_0$	75.00	80.00	50.00	45.00	36.00	27.50	23.75	32.50	56.25	55.00	85.00	80.00	53.83
14	$N_0P_3K_1$	70.00	80.00	46.00	54.00	40.00	23.00	30.00	40.00	50.00	70.00	90.00	95.00	57.33
15	$N_0P_3K_2$	76.00	61.00	44.00	37.50	26.70	36.30	34.00	40.00	51.00	74.00	70.00	84.00	52.88
16	$N_0P_3K_3$	86.00	60.00	59.00	50.00	43.80	32.50	31.66	45.00	50.00	80.00	90.00	120.00	62.33
17	$N_1P_0K_0$	77.00	75.00	52.00	50.00	40.21	38.48	40.30	62.00	78.00	87.50	77.43	68.00	62.16
18	$N_1P_0K_1$	74.00	63.00	62.00	51.00	32.00	30.00	53.95	52.38	60.00	62.00	70.00	72.50	56.90
19	$N_1P_0K_2$	84.00	70.00	65.80	62.50	40.00	35.50	36.30	46.25	62.00	75.00	78.77	73.00	60.76
20	$N_1P_0K_3$	95.00	75.00	52.00	40.00	32.00	26.00	35.00	68.75	70.00	88.00	90.00	100.00	64.31
21	$N_1P_1K_0$	87.50	60.00	55.00	50.00	32.00	32.50	55.00	60.00	65.00	86.00	90.00	100.00	64.42
22	$N_1P_1K_1$	90.00	100.00	60.00	42.00	52.00	48.00	47.00	51.00	60.00	84.00	90.00	97.00	68.42
23	$N_1P_1K_2$	72.00	55.00	55.00	45.00	28.00	32.50	50.00	54.00	56.00	60.90	71.00	70.00	54.12
24	$N_1P_1K_3$	100.00	70.00	50.00	44.00	36.30	25.22	28.00	50.00	60.00	83.00	95.00	96.00	61.46
25	$N_1P_2K_0$	65.00	55.00	42.50	38.00	29.00	27.00	30.00	35.00	40.00	50.00	73.33	86.66	47.62
26	$N_1P_2K_1$	80.00	60.00	53.80	52.50	30.00	25.00	32.50	36.00	90.00	60.00	86.67	95.00	58.46
27	$N_1P_2K_2$	104.00	76.00	42.00	50.00	31.30	21.00	33.30	40.00	62.00	80.00	71.00	110.00	60.05
28	$N_1P_2K_3$	72.00	62.50	50.00	45.00	31.30	28.33	35.00	54.75	77.00	75.00	100.00	107.00	61.49
29	$N_1P_3K_0$	76.00	60.00	44.00	40.50	30.00	33.80	38.66	40.00	47.00	54.00	67.00	76.96	50.66
30	$N_1P_3K_1$	97.00	53.00	42.00	40.00	28.80	27.50	35.00	37.00	98.00	65.00	87.50	102.00	59.40
31	$N_1P_3K_2$	90.00	73.70	53.30	65.70	41.00	40.00	42.00	49.83	55.00	60.30	73.00	80.00	60.32
32	$N_1P_3K_3$	94.00	72.00	40.00	30.00	35.00	36.30	28.00	41.67	41.50	70.00	75.00	87.50	54.25
33	$N_2P_0K_0$	90.00	70.00	45.00	50.00	37.50	35.00	28.00	50.00	64.75	65.00	70.00	62.00	55.60

(Contd. Appendix LXL)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	72.50	58.00	45.00	40.00	30.00	33.00	38.75	57.00	56.25	92.00	78.00	95.00	**57.96**
35	$N_2P_0K_2$	86.00	60.00	48.30	40.00	26.00	33.30	27.00	62.50	71.25	68.75	88.00	90.00	**58.43**
36	$N_2P_0K_3$	80.00	60.00	59.00	48.00	45.00	35.00	45.00	53.00	65.00	83.00	82.83	90.00	**62.15**
37	$N_2P_1K_0$	62.00	60.00	53.00	50.00	40.00	47.50	44.00	45.00	47.00	66.75	71.00	74.00	**55.02**
38	$N_2P_1K_1$	70.00	61.00	53.00	47.00	43.00	45.00	54.13	52.54	58.00	62.50	66.00	76.66	**57.40**
39	$N_2P_1K_2$	80.00	76.00	61.00	54.00	56.00	36.00	28.00	56.00	64.00	75.00	80.00	90.00	**63.00**
40	$N_2P_1K_3$	65.00	58.30	48.00	44.00	40.00	25.00	22.50	32.50	50.00	66.67	65.00	78.00	**49.58**
41	$N_2P_2K_0$	106.00	85.00	60.00	55.00	30.25	40.00	55.00	70.00	100.00	92.00	109.00	106.00	**75.69**
42	$N_2P_2K_1$	100.00	56.00	44.00	50.00	40.00	25.00	48.00	53.00	79.05	77.84	95.00	105.00	**64.41**
43	$N_2P_2K_2$	62.00	60.00	45.00	40.00	50.00	32.50	47.00	50.00	70.00	60.00	75.00	102.00	**57.79**
44	$N_2P_2K_3$	115.00	70.97	61.00	68.00	50.00	37.56	40.00	41.00	73.75	80.00	113.00	110.00	**71.69**
45	$N_2P_3K_0$	100.50	75.00	66.00	60.25	57.83	47.00	60.00	65.00	76.00	83.00	82.00	90.00	**71.88**
46	$N_2P_3K_1$	100.00	66.70	61.70	66.70	50.96	36.70	31.66	45.00	60.00	69.00	75.00	66.66	**60.84**
47	$N_2P_3K_2$	80.00	70.00	56.00	42.50	25.00	26.00	35.00	56.25	60.00	58.00	74.00	82.00	**55.40**
48	$N_2P_3K_3$	60.00	55.00	42.00	50.50	45.00	31.30	45.00	47.50	52.00	50.00	61.67	67.47	**50.62**
49	$N_3P_0K_0$	72.00	76.70	75.00	60.00	56.00	36.00	49.00	54.00	78.30	73.00	83.63	90.00	**66.97**
50	$N_3P_0K_1$	116.00	90.00	70.00	52.00	32.00	40.00	55.00	57.50	62.50	72.00	95.00	97.00	**69.92**
51	$N_3P_0K_2$	92.00	79.00	60.36	50.00	38.00	35.00	50.00	62.00	70.00	78.00	93.00	100.00	**67.28**
52	$N_3P_0K_3$	88.00	90.00	51.00	44.00	37.50	29.00	47.50	51.50	75.00	80.00	86.00	85.00	**63.71**
53	$N_3P_1K_0$	60.00	50.00	30.00	23.80	30.00	35.00	53.00	45.83	62.00	55.00	68.75	70.00	**48.62**
54	$N_3P_1K_1$	70.00	65.00	66.00	60.00	48.00	50.00	45.00	70.00	68.00	82.00	95.00	88.00	**67.25**
55	$N_3P_1K_2$	84.00	78.80	55.45	52.50	42.00	47.00	54.00	62.50	70.00	63.75	70.00	73.00	**62.75**
56	$N_3P_1K_3$	70.00	57.00	49.00	40.00	35.50	31.63	37.25	53.00	68.75	80.00	83.00	90.00	**57.93**
57	$N_3P_2K_0$	68.80	59.00	47.75	36.00	30.70	28.70	35.00	40.00	59.00	57.00	79.00	81.00	**51.83**
58	$N_3P_2K_1$	92.00	62.00	61.00	49.00	30.00	39.00	53.00	56.00	67.50	80.00	110.00	108.00	**67.29**
59	$N_3P_2K_2$	68.80	81.30	57.00	52.33	25.00	30.00	35.00	48.00	63.00	60.00	71.00	70.00	**55.12**
60	$N_3P_2K_3$	100.00	65.00	49.00	51.00	50.00	46.30	27.50	45.00	80.00	67.34	91.00	100.00	**64.35**
61	$N_3P_3K_0$	106.00	100.00	69.00	50.00	33.33	42.50	40.00	56.00	62.00	56.75	86.67	100.00	**68.85**
62	$N_3P_3K_1$	90.00	70.00	44.25	50.00	40.00	27.39	25.96	50.00	75.00	70.00	93.00	90.00	**60.47**
63	$N_3P_3K_2$	75.00	50.00	36.00	41.70	27.52	31.00	50.00	47.00	48.00	52.00	56.00	50.30	**47.64**
64	$N_3P_3K_3$	84.00	60.00	52.00	57.50	30.00	38.30	45.00	42.75	62.50	60.00	88.00	101.00	**60.09**
	Mean	80.94	67.18	52.42	42.99	35.60	37.14	45.39	57.49	65.86	76.47	83.44	73.38	**59.41**
	%CV	17.48	16.64	16.54	22.15	19.90	27.93	24.60	23.16	19.64	17.89	16.29	22.32	**10.56**

Appendix LXII. Monthly production of latex (cc/tree/tap) in block-1 of site -3 during October 1995 to September 1996.

SL	Treatment	1995			1996									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	95.00	90.00	93.50	64.00	27.06	40.00	46.00	50.00	67.00	66.00	75.00	80.00	66.13
2	$N_0P_0K_1$	84.00	98.00	90.00	55.00	40.00	42.96	41.00	39.00	50.00	58.00	62.00	79.00	61.58
3	$N_0P_0K_2$	109.00	90.00	75.00	57.50	35.00	52.54	51.00	53.00	68.00	70.00	86.00	84.00	69.25
4	$N_0P_0K_3$	92.00	88.00	55.00	48.00	30.05	41.00	52.00	69.00	73.75	71.00	83.00	88.00	65.90
5	$N_0P_1K_0$	110.00	115.00	80.00	55.00	40.00	50.00	49.00	65.00	70.00	81.00	98.00	102.00	76.25
6	$N_0P_1K_1$	101.00	103.08	95.00	70.00	57.50	35.50	50.00	57.71	67.00	75.00	88.00	84.00	73.65
7	$N_0P_1K_2$	95.00	110.00	87.50	75.00	43.00	44.50	63.00	62.00	66.67	68.17	86.00	90.00	74.24
8	$N_0P_1K_3$	95.00	105.00	70.00	57.00	38.00	43.00	52.00	64.00	81.00	81.84	85.00	90.00	71.82
9	$N_0P_2K_0$	96.00	120.00	95.00	65.00	45.00	35.00	53.00	75.00	81.00	70.00	74.00	85.00	74.50
10	$N_0P_2K_1$	101.00	106.00	75.00	49.50	40.00	50.00	65.00	60.00	99.00	98.00	100.00	125.00	80.71
11	$N_0P_2K_2$	68.00	65.00	68.75	60.00	63.00	65.00	64.61	87.00	95.00	98.00	103.00	108.00	78.78
12	$N_0P_2K_3$	102.00	116.00	90.00	66.00	55.00	57.00	60.00	76.00	83.00	85.36	94.00	91.96	81.36
13	$N_0P_3K_0$	80.00	106.00	94.00	60.00	35.00	39.00	40.00	56.00	66.00	75.00	80.00	72.00	66.92
14	$N_0P_3K_1$	90.38	100.00	87.00	70.00	50.00	61.87	70.00	73.00	60.00	80.00	97.00	94.07	78.78
15	$N_0P_3K_2$	110.00	104.00	90.00	50.00	60.00	65.00	61.00	80.00	85.00	76.42	100.00	112.50	82.83
16	$N_0P_3K_3$	93.00	100.00	85.00	40.00	35.20	30.00	45.00	60.00	87.00	78.00	98.00	87.00	69.85
17	$N_1P_0K_0$	120.00	90.00	105.00	75.00	45.96	55.00	60.00	65.00	99.00	104.00	115.00	105.00	86.58
18	$N_1P_0K_1$	77.00	97.00	74.00	60.00	40.00	47.50	64.00	55.00	67.00	75.00	90.00	90.98	69.79
19	$N_1P_0K_2$	116.00	120.00	80.00	55.00	40.00	45.00	47.00	50.00	57.50	65.00	69.00	71.00	67.96
20	$N_1P_0K_3$	105.00	125.00	100.00	65.00	49.25	50.00	54.00	55.00	87.00	63.80	80.00	103.00	78.09
21	$N_1P_1K_0$	108.00	100.00	92.50	60.00	50.00	47.50	64.00	70.00	72.50	93.00	100.00	107.00	80.38
22	$N_1P_1K_1$	118.00	122.00	105.00	55.00	40.00	45.00	53.00	60.00	75.00	86.00	73.00	79.00	75.92
23	$N_1P_1K_2$	91.00	101.00	90.00	65.00	50.00	52.00	42.00	45.00	65.00	75.04	69.00	89.00	69.50
24	$N_1P_1K_3$	83.00	112.00	70.00	60.00	33.00	41.25	50.00	55.00	66.67	73.25	75.00	78.00	66.43
25	$N_1P_2K_0$	104.00	115.00	70.00	67.00	60.00	50.00	50.16	63.00	60.00	79.00	70.00	90.00	73.18
26	$N_1P_2K_1$	136.00	160.00	100.00	76.00	55.00	66.00	62.00	63.00	82.00	94.00	108.00	120.00	93.50
27	$N_1P_2K_2$	80.00	87.50	65.00	51.00	47.00	40.00	50.00	63.82	67.00	64.00	73.00	78.00	63.86
28	$N_1P_2K_3$	97.00	102.00	70.00	53.64	55.00	31.92	51.67	63.00	72.64	70.68	65.00	85.00	68.13
29	$N_1P_3K_0$	92.50	100.00	75.00	61.00	37.50	35.00	50.00	67.50	75.00	70.00	83.00	84.00	69.21
30	$N_1P_3K_1$	112.00	80.00	68.75	35.25	42.00	60.00	62.20	60.00	71.00	80.00	78.23	78.00	68.96
31	$N_1P_3K_2$	124.00	130.00	120.00	60.00	55.00	65.00	60.00	80.00	85.00	65.00	86.00	99.00	85.75
32	$N_1P_3K_3$	120.00	129.00	76.00	50.00	40.00	56.25	37.50	55.00	67.50	70.00	80.00	81.25	71.88
33	$N_2P_0K_0$	100.00	120.00	110.00	70.00	37.00	50.00	64.00	65.00	75.00	68.00	70.00	115.00	78.67

(Contd. Appendix LXII.)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	110.00	89.00	100.00	80.00	49.00	51.00	45.00	50.00	56.00	55.00	69.00	70.00	68.67
35	$N_2P_0K_2$	120.00	140.00	110.00	68.00	35.00	49.00	46.00	59.00	68.76	90.00	89.00	98.00	81.06
36	$N_2P_0K_3$	120.00	130.00	120.00	85.00	59.00	40.00	58.00	75.00	95.00	85.00	87.50	110.00	88.71
37	$N_2P_1K_0$	107.00	118.00	67.00	55.00	35.00	55.00	60.00	75.00	70.00	83.00	90.00	100.00	76.25
38	$N_2P_1K_1$	120.00	108.00	90.00	77.50	65.00	55.50	69.80	70.00	85.00	90.00	99.72	104.00	86.21
39	$N_2P_1K_2$	105.00	121.00	80.00	59.00	40.30	53.75	63.00	61.67	67.50	72.50	105.00	92.00	76.73
40	$N_2P_1K_3$	90.00	105.00	60.00	40.00	34.00	30.00	50.00	59.00	71.00	71.80	89.28	79.00	64.92
41	$N_2P_2K_0$	110.00	116.67	66.00	53.00	34.00	43.66	62.00	56.00	83.36	96.00	108.00	120.00	79.06
42	$N_2P_2K_1$	112.00	130.00	85.00	62.00	35.00	38.00	50.00	62.00	77.04	76.96	84.00	84.00	75.50
43	$N_2P_2K_2$	122.00	140.00	110.00	65.00	40.00	54.00	73.30	78.75	83.00	90.00	102.00	107.19	88.77
44	$N_2P_2K_3$	87.00	110.00	80.00	50.00	44.00	53.00	60.00	66.67	81.25	82.00	94.97	116.67	77.13
45	$N_2P_3K_0$	82.00	83.30	80.00	75.00	45.00	55.00	64.00	72.00	72.64	87.00	88.00	101.00	75.36
46	$N_2P_3K_1$	80.00	78.00	57.00	45.00	35.67	34.60	55.00	66.67	70.67	80.00	96.43	107.00	67.17
47	$N_2P_3K_2$	96.00	80.00	60.00	58.00	34.96	42.00	41.00	50.00	65.00	77.00	84.00	80.00	64.00
48	$N_2P_3K_3$	114.00	120.00	80.00	66.00	30.00	33.00	37.00	40.00	65.00	74.00	80.00	72.00	67.58
49	$N_3P_0K_0$	107.00	120.00	90.00	68.75	40.00	50.00	58.00	100.00	98.25	97.50	110.00	116.67	88.01
50	$N_3P_0K_1$	96.00	110.00	80.00	55.00	44.00	35.00	51.00	55.00	72.00	76.00	88.00	93.96	71.33
51	$N_3P_0K_2$	121.00	124.00	81.00	60.00	35.00	45.00	43.75	60.00	78.00	76.00	80.00	95.00	74.90
52	$N_3P_0K_3$	105.00	90.00	70.00	65.00	37.50	40.00	60.00	71.00	69.00	88.00	87.00	100.00	73.54
53	$N_3P_1K_0$	83.30	112.00	66.00	59.00	53.00	39.70	56.00	67.00	65.00	78.00	73.00	89.00	70.00
54	$N_3P_1K_1$	96.00	112.00	85.00	55.00	40.63	50.00	63.30	72.50	85.00	93.86	133.00	120.00	83.86
55	$N_3P_1K_2$	104.00	96.71	81.00	60.00	40.00	58.00	55.00	60.00	75.00	82.65	90.00	81.00	73.61
56	$N_3P_1K_3$	120.00	117.00	90.00	65.00	60.00	40.00	60.00	62.00	86.00	82.27	100.00	105.00	82.27
57	$N_3P_2K_0$	86.00	106.00	65.00	50.00	44.00	35.00	50.00	64.00	70.00	60.00	78.00	80.00	65.67
58	$N_3P_2K_1$	101.00	150.00	100.00	75.00	55.23	48.75	53.30	67.50	83.75	88.00	105.00	118.75	87.19
59	$N_3P_2K_2$	96.00	110.00	66.25	56.00	50.00	35.00	54.00	58.00	75.00	88.30	91.00	107.75	73.94
60	$N_3P_2K_3$	100.00	128.00	65.00	70.00	60.00	55.00	50.00	46.00	64.00	78.00	75.00	85.00	73.00
61	$N_3P_3K_0$	77.96	84.00	65.00	50.00	38.04	50.00	55.00	61.00	68.00	70.00	80.00	82.00	65.08
62	$N_3P_3K_1$	81.00	130.00	80.00	51.00	52.00	53.25	54.00	65.00	76.00	80.00	77.00	95.00	74.52
63	$N_3P_3K_2$	99.32	110.00	90.00	60.00	30.00	40.00	58.00	52.00	66.00	65.00	70.00	84.00	68.69
64	$N_3P_3K_3$	99.75	120.00	90.00	50.00	30.00	35.00	62.58	67.50	73.00	76.00	86.25	95.00	73.76
Mean		100.97	109.47	82.97	60.14	43.69	46.75	54.72	63.00	74.65	78.40	87.40	93.98	74.62
%CV		14.10	16.34	18.45	16.59	21.76	20.24	14.99	16.90	14.34	13.53	15.56	15.13	9.81

Appendix LXIII. Monthly production of latex (cc/tree/tap) in block-2 of site-3 during October 1995 to September 1996.

SL	Treatment	1995			1996									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	82.50	80.00	66.25	60.00	45.00	58.75	50.00	58.00	66.97	65.00	67.50	71.75	64.31
2	$N_0P_0K_1$	88.75	84.00	79.00	54.00	60.00	40.00	54.00	56.00	70.00	80.00	78.00	88.00	69.31
3	$N_0P_0K_2$	95.00	97.00	70.00	60.00	56.00	50.00	55.00	70.00	88.00	80.00	89.00	87.00	74.75
4	$N_0P_0K_3$	85.00	97.00	68.00	57.00	50.00	43.75	41.67	50.00	70.00	81.25	65.50	70.00	64.93
5	$N_0P_1K_0$	110.00	89.00	70.00	66.00	50.00	60.00	67.67	71.25	80.00	90.00	98.75	100.00	79.39
6	$N_0P_1K_1$	87.50	90.00	75.00	60.00	41.25	35.00	50.00	57.50	90.00	80.00	74.56	76.67	68.12
7	$N_0P_1K_2$	111.00	100.00	70.95	61.00	50.00	54.00	53.75	71.00	90.00	97.50	75.00	109.00	78.60
8	$N_0P_1K_3$	113.00	100.00	75.00	64.00	65.00	50.00	54.00	60.00	73.33	80.00	85.00	81.00	75.03
9	$N_0P_2K_0$	105.00	100.00	80.00	65.00	40.00	66.67	63.00	68.00	73.00	82.33	80.00	97.00	76.67
10	$N_0P_2K_1$	120.00	118.00	110.00	67.00	68.00	63.00	65.00	67.54	87.50	90.00	80.00	95.00	85.92
11	$N_0P_2K_2$	80.37	90.00	62.50	54.00	43.75	35.00	67.50	75.00	73.00	118.00	104.00	103.00	75.51
12	$N_0P_2K_3$	97.67	89.00	80.00	66.67	52.50	58.33	50.00	70.00	92.50	90.00	78.00	87.30	76.00
13	$N_0P_3K_0$	83.33	90.00	70.00	45.00	40.00	55.00	57.00	63.37	70.00	95.00	90.50	100.00	73.35
14	$N_0P_3K_1$	100.00	95.00	110.00	80.00	60.00	46.00	70.00	72.00	92.50	80.00	110.00	100.00	84.63
15	$N_0P_3K_2$	110.00	112.00	68.00	60.00	50.00	45.00	65.00	60.00	90.00	112.42	120.00	110.00	83.54
16	$N_0P_3K_3$	109.00	69.75	65.92	42.00	40.00	45.49	55.00	50.00	110.00	120.00	80.00	130.00	76.43
17	$N_1P_0K_0$	98.68	95.67	65.00	61.00	40.00	52.00	53.00	68.00	81.00	85.00	101.00	107.57	75.66
18	$N_1P_0K_1$	94.19	85.00	60.00	52.00	41.30	50.00	68.26	77.50	86.67	91.00	93.00	81.61	73.38
19	$N_1P_0K_2$	102.00	94.00	69.67	63.34	31.00	55.00	66.67	60.00	98.00	103.00	87.00	102.00	77.64
20	$N_1P_0K_3$	110.70	102.00	81.00	86.00	60.00	32.50	53.00	67.00	80.00	106.00	97.00	110.00	82.10
21	$N_1P_1K_0$	108.60	112.00	87.00	70.00	60.00	53.30	50.00	75.00	95.00	104.00	114.00	114.98	86.99
22	$N_1P_1K_1$	130.00	125.00	90.00	67.00	66.00	60.00	55.00	70.00	78.00	75.00	80.00	117.00	84.42
23	$N_1P_1K_2$	112.00	100.00	68.00	61.00	40.00	53.30	65.00	57.50	62.50	82.50	105.00	82.97	74.15
24	$N_1P_1K_3$	118.00	112.00	61.33	50.00	55.00	51.00	56.00	65.00	74.00	77.03	87.00	82.00	74.03
25	$N_1P_2K_0$	112.50	94.00	60.00	56.00	44.00	35.00	50.00	52.00	78.00	75.00	90.00	100.00	70.54
26	$N_1P_2K_1$	95.00	110.00	70.00	66.00	52.00	75.00	72.00	70.00	89.64	77.00	98.00	120.00	82.89
27	$N_1P_2K_2$	100.00	104.00	78.00	56.25	40.00	50.00	52.00	73.00	80.00	83.35	85.00	75.00	73.05
28	$N_1P_2K_3$	83.33	100.00	75.00	66.67	50.00	51.00	52.00	64.67	106.25	87.00	75.00	77.00	73.99
29	$N_1P_3K_0$	82.00	80.00	64.00	65.00	59.00	57.57	56.00	62.50	76.00	82.00	80.00	87.50	70.96
30	$N_1P_3K_1$	90.00	87.00	68.75	65.00	47.00	56.00	52.00	65.00	78.00	83.00	92.00	104.00	73.98
31	$N_1P_3K_2$	119.00	106.00	95.00	70.00	60.00	55.00	65.00	80.00	99.00	110.00	100.00	120.00	89.92
32	$N_1P_3K_3$	80.00	95.00	90.00	65.00	50.00	45.00	44.00	56.00	60.00	84.00	80.00	86.00	69.58
33	$N_2P_0K_0$	109.00	105.00	85.00	66.25	56.00	67.52	76.67	80.00	91.00	107.00	99.00	106.00	87.37

(Contd. Appendix LXIII.)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	105.00	100.00	72.50	50.00	37.50	37.00	47.00	60.00	75.00	87.50	93.42	90.00	71.24
35	$N_2P_0K_2$	90.00	88.00	65.00	60.00	56.00	46.00	50.72	70.00	81.00	85.00	87.00	98.00	73.06
36	$N_2P_0K_3$	116.00	104.00	82.00	68.00	40.00	63.83	57.00	62.50	115.00	105.00	101.00	92.44	83.90
37	$N_2P_1K_0$	118.58	126.00	90.00	73.00	62.50	65.00	50.00	75.00	80.00	87.00	98.00	112.00	86.42
38	$N_2P_1K_1$	123.00	107.00	78.00	65.00	63.33	56.00	58.00	64.67	70.00	92.00	96.00	105.00	81.50
39	$N_2P_1K_2$	115.00	116.00	90.00	50.00	55.00	45.37	67.50	40.00	60.00	57.00	64.25	63.00	68.59
40	$N_2P_1K_3$	113.30	100.00	75.00	55.00	48.00	32.00	60.00	67.50	62.50	77.00	80.00	72.55	70.24
41	$N_2P_2K_0$	110.00	120.00	95.00	90.00	70.00	50.00	57.00	75.00	80.00	99.00	90.00	104.00	86.67
42	$N_2P_2K_1$	87.50	90.00	80.00	65.00	41.00	39.00	52.54	55.00	70.00	80.00	86.00	84.00	69.17
43	$N_2P_2K_2$	108.00	100.00	70.00	66.00	50.00	61.25	58.00	64.00	95.00	110.50	104.73	106.00	82.79
44	$N_2P_2K_3$	98.00	110.00	80.00	68.00	54.00	50.00	63.30	78.00	90.00	105.00	102.00	92.70	82.58
45	$N_2P_3K_0$	112.50	130.00	126.00	100.00	70.00	75.00	55.00	60.00	70.00	80.00	85.00	110.00	89.46
46	$N_2P_3K_1$	112.00	100.00	68.25	65.00	44.00	37.50	50.00	60.00	75.00	80.00	90.00	94.00	72.98
47	$N_2P_3K_2$	87.50	90.00	75.00	66.00	50.00	45.00	52.50	66.25	68.00	75.00	87.50	92.50	71.27
48	$N_2P_3K_3$	110.00	87.50	80.00	75.00	60.00	45.00	35.00	50.00	85.00	90.00	75.00	84.00	73.04
49	$N_3P_0K_0$	119.94	110.00	78.75	65.00	50.00	53.75	67.50	69.50	72.62	81.25	87.50	91.57	78.95
50	$N_3P_0K_1$	95.00	105.00	70.00	68.00	58.00	60.00	71.25	60.00	87.00	85.00	80.00	91.00	77.52
51	$N_3P_0K_2$	97.80	98.00	83.00	63.30	50.00	53.00	59.00	67.44	80.88	92.00	87.50	95.00	77.24
52	$N_3P_0K_3$	94.00	101.00	75.00	68.00	56.00	50.00	75.00	73.67	77.00	75.00	97.50	81.25	76.95
53	$N_3P_1K_0$	110.00	130.00	70.00	60.00	50.00	35.00	46.00	50.00	110.00	80.00	82.00	90.00	76.08
54	$N_3P_1K_1$	112.50	120.00	65.00	66.00	56.00	55.00	75.00	60.00	112.50	100.00	120.00	124.00	88.83
55	$N_3P_1K_2$	120.00	86.67	85.00	64.00	60.00	45.00	61.00	65.00	70.00	90.00	94.00	100.00	78.39
56	$N_3P_1K_3$	100.00	118.00	75.00	55.00	52.00	50.00	55.75	58.00	80.00	100.00	95.00	125.00	80.31
57	$N_3P_2K_0$	90.00	83.00	55.00	45.00	35.00	31.00	44.00	47.00	68.00	74.00	85.00	96.00	62.75
58	$N_3P_2K_1$	105.00	100.00	80.00	56.00	50.00	40.00	65.00	84.00	80.00	86.00	90.00	109.00	78.75
59	$N_3P_2K_2$	87.50	95.00	80.00	60.00	25.00	20.00	37.75	56.00	70.00	73.00	87.00	89.00	65.02
60	$N_3P_2K_3$	102.00	98.00	80.00	50.00	25.00	28.00	38.00	50.00	110.00	125.00	117.00	102.50	77.13
61	$N_3P_3K_0$	96.67	104.67	70.00	50.00	45.00	56.30	50.00	65.00	64.00	70.00	85.00	86.00	70.22
62	$N_3P_3K_1$	95.00	107.50	85.00	64.00	60.00	40.00	43.75	60.00	95.00	96.00	90.00	100.00	78.02
63	$N_3P_3K_2$	110.00	119.00	75.00	60.00	40.00	50.00	62.50	65.00	75.00	72.00	80.00	85.00	74.46
64	$N_3P_3K_3$	87.50	80.00	75.00	66.00	64.00	50.17	47.50	60.00	70.00	78.00	75.00	76.00	69.10
	Mean	102.38	100.50	76.83	62.88	50.63	49.50	56.54	64.20	81.69	88.37	89.65	95.64	76.51
	%CV	12.12	12.91	16.10	15.68	20.09	22.18	16.74	14.02	16.46	15.76	13.73	15.18	8.63

Appendix LXIV. Monthly production of latex (cc/tree/tap) in block-3 of site-3 during October 1995 to September 1996.

SL	Treatment	1995			1996									
		O	N	D	J	F	M	A	M	J	J	A	S	Av
1	$N_0P_0K_0$	80.00	76.71	65.00	53.75	40.00	50.00	45.00	37.50	56.00	70.00	62.50	68.18	58.72
2	$N_0P_0K_1$	83.33	110.00	89.48	60.00	53.00	51.33	47.50	65.00	85.00	90.00	70.00	74.00	73.22
3	$N_0P_0K_2$	95.00	90.00	118.50	80.00	65.00	59.00	48.30	49.30	75.00	83.41	79.00	82.00	77.04
4	$N_0P_0K_3$	93.00	84.00	86.00	66.00	49.00	58.00	36.00	43.00	51.00	67.00	87.50	79.00	66.63
5	$N_0P_1K_0$	95.00	110.00	78.00	80.00	62.00	60.00	50.48	78.00	100.00	105.00	97.98	80.00	83.04
6	$N_0P_1K_1$	110.00	98.00	83.34	60.00	50.00	40.33	59.74	72.00	83.00	95.00	105.00	100.00	79.70
7	$N_0P_1K_2$	78.00	100.00	70.00	60.00	50.00	54.00	72.00	93.75	91.00	98.00	100.00	123.00	82.48
8	$N_0P_1K_3$	82.50	90.00	71.00	60.00	52.30	48.00	45.00	65.00	93.97	106.00	123.00	104.00	78.40
9	$N_0P_2K_0$	76.67	106.00	65.00	50.00	52.50	56.25	45.00	68.75	73.00	80.00	77.00	81.25	69.29
10	$N_0P_2K_1$	80.00	125.00	100.00	75.00	87.50	62.50	50.00	76.00	96.00	114.00	111.00	100.00	89.75
11	$N_0P_2K_2$	100.00	110.00	64.00	60.00	48.75	42.50	46.67	60.00	76.00	83.83	87.00	93.75	72.71
12	$N_0P_2K_3$	95.00	100.00	60.00	45.00	32.50	43.75	40.00	50.00	75.00	91.00	69.00	90.00	65.94
13	$N_0P_3K_0$	115.00	110.00	60.00	65.25	37.50	58.33	44.67	43.75	50.00	116.67	107.00	87.50	74.64
14	$N_0P_3K_1$	110.00	119.00	61.00	62.50	43.75	50.00	37.50	55.00	58.56	80.42	94.00	86.00	71.48
15	$N_0P_3K_2$	112.00	120.00	85.00	70.00	45.00	66.67	49.66	61.00	65.00	97.00	117.00	110.00	83.19
16	$N_0P_3K_3$	120.00	110.00	80.00	50.00	41.67	43.30	51.24	63.33	62.50	82.50	70.00	80.00	71.21
17	$N_1P_0K_0$	112.50	110.00	65.00	50.00	58.00	68.75	62.50	75.00	80.00	92.00	100.00	107.50	81.77
18	$N_1P_0K_1$	100.00	107.00	64.83	62.50	47.50	43.30	59.96	62.65	87.50	96.00	105.00	102.00	78.19
19	$N_1P_0K_2$	116.67	120.00	62.50	57.50	66.67	80.00	43.30	66.67	82.50	108.33	103.96	63.75	80.99
20	$N_1P_0K_3$	95.00	121.65	88.00	80.00	65.00	55.00	75.00	86.25	93.33	92.50	98.00	96.67	87.20
21	$N_1P_1K_0$	115.83	108.00	75.00	50.00	52.50	40.00	58.91	47.50	75.00	80.00	70.00	54.14	68.91
22	$N_1P_1K_1$	97.50	115.00	63.00	58.40	50.00	40.00	66.67	67.50	104.00	83.33	102.00	118.00	80.45
23	$N_1P_1K_2$	75.00	100.00	50.00	37.50	40.00	43.75	50.00	55.00	87.50	83.00	75.00	75.33	64.34
24	$N_1P_1K_3$	90.00	120.00	70.00	58.34	35.00	33.33	70.00	87.50	75.00	90.00	58.33	52.50	70.00
25	$N_1P_2K_0$	110.00	100.00	70.00	60.00	66.67	39.00	59.00	62.50	91.00	96.00	92.50	66.67	76.11
26	$N_1P_2K_1$	115.00	120.00	64.00	60.00	70.00	56.00	68.00	75.00	100.00	95.00	102.00	125.00	87.50
27	$N_1P_2K_2$	112.50	110.00	55.00	52.00	50.00	43.75	50.00	51.00	73.30	87.00	69.00	69.60	68.60
28	$N_1P_2K_3$	116.67	120.00	64.00	65.00	56.25	50.00	53.30	55.00	80.00	91.67	70.00	80.00	75.16
29	$N_1P_3K_0$	91.00	80.00	50.00	57.50	50.00	34.00	37.67	35.00	75.00	90.00	114.00	86.00	66.68
30	$N_1P_3K_1$	106.00	90.00	77.50	63.00	52.50	63.75	62.50	72.12	67.75	86.11	95.00	93.00	77.26
31	$N_1P_3K_2$	105.00	116.67	90.00	80.00	70.00	60.00	82.68	85.00	96.00	112.50	99.75	115.00	92.72
32	$N_1P_3K_3$	108.00	80.00	56.26	62.67	50.00	37.50	50.00	66.55	70.00	102.00	100.00	77.00	71.67
33	$N_2P_0K_0$	77.50	80.00	75.00	60.00	51.73	58.33	56.00	53.00	64.00	72.00	66.00	104.00	68.13

(Contd. Appendix LXIV.)

SL	Treatment	O	N	D	J	F	M	A	M	J	J	A	S	Av
34	$N_2P_0K_1$	97.00	85.00	51.67	43.34	45.00	52.00	67.00	73.00	75.00	78.00	83.00	85.00	69.58
35	$N_2P_0K_2$	85.81	80.00	62.50	56.00	47.67	43.75	67.00	63.00	78.00	66.67	76.00	74.00	66.70
36	$N_2P_0K_3$	100.00	102.00	80.00	70.00	51.67	58.00	59.00	62.50	88.78	95.50	87.50	83.57	78.21
37	$N_2P_1K_0$	70.00	90.00	54.00	52.00	50.00	35.00	56.36	67.50	76.00	78.00	87.50	80.00	66.36
38	$N_2P_1K_1$	90.00	95.00	55.00	60.00	55.00	65.00	68.00	62.58	90.00	80.00	81.25	115.00	76.40
39	$N_2P_1K_2$	94.00	90.00	79.00	76.29	70.00	45.96	69.00	60.00	74.00	80.00	103.00	118.00	79.94
40	$N_2P_1K_3$	100.00	125.00	80.00	43.75	50.00	30.00	50.00	75.00	75.95	87.50	110.00	80.00	75.60
41	$N_2P_2K_0$	90.00	120.00	77.00	62.00	58.08	50.00	68.00	73.00	90.00	101.00	100.00	90.00	81.59
42	$N_2P_2K_1$	100.00	120.00	55.00	62.50	52.50	47.50	41.31	75.00	90.00	100.00	66.67	74.40	73.74
43	$N_2P_2K_2$	120.00	110.00	76.00	70.00	65.00	53.75	75.00	86.67	80.00	96.00	126.97	133.33	91.06
44	$N_2P_2K_3$	120.00	131.98	62.50	65.00	60.00	62.50	58.75	81.00	79.00	110.00	123.30	112.50	88.88
45	$N_2P_3K_0$	118.00	120.00	78.00	65.75	50.00	69.00	75.00	81.71	81.00	75.00	102.00	97.50	84.41
46	$N_2P_3K_1$	126.59	101.44	68.00	60.00	58.75	61.00	50.00	62.58	81.04	93.00	104.00	100.00	80.53
47	$N_2P_3K_2$	91.00	90.00	64.00	61.00	50.00	40.00	34.00	56.00	58.00	75.00	80.00	96.00	66.25
48	$N_2P_3K_3$	112.50	120.00	70.00	64.00	52.33	46.78	53.00	67.75	93.68	97.00	93.00	92.00	80.17
49	$N_3P_0K_0$	112.18	100.00	88.00	66.00	67.00	56.00	54.00	70.00	79.00	100.00	93.70	99.00	82.07
50	$N_3P_0K_1$	120.00	110.00	60.00	94.00	82.00	60.00	50.00	80.00	90.00	80.00	75.00	118.75	84.98
51	$N_3P_0K_2$	110.00	105.00	90.00	80.00	47.00	56.00	63.30	66.67	80.00	96.00	102.00	96.67	82.72
52	$N_3P_0K_3$	93.75	109.00	85.00	70.00	66.00	60.25	58.12	78.00	75.00	83.00	86.00	82.00	78.84
53	$N_3P_1K_0$	75.00	66.97	58.00	56.00	52.50	50.00	45.00	63.30	81.00	70.00	75.00	80.00	64.40
54	$N_3P_1K_1$	90.00	86.00	84.00	70.00	60.00	61.00	59.00	64.00	75.00	116.63	100.00	90.00	79.64
55	$N_3P_1K_2$	83.33	95.00	90.00	60.00	50.00	52.00	48.96	61.67	88.00	102.50	97.00	87.00	76.29
56	$N_3P_1K_3$	83.00	106.00	80.00	70.00	61.71	44.58	45.00	67.50	76.00	75.00	93.30	89.00	74.26
57	$N_3P_2K_0$	99.00	85.00	52.50	56.67	52.57	40.00	45.00	50.80	64.00	80.00	83.54	85.00	66.17
58	$N_3P_2K_1$	100.00	90.00	75.00	65.00	50.00	60.00	62.50	87.50	85.00	93.75	100.00	127.97	83.06
59	$N_3P_2K_2$	92.50	88.00	64.00	45.00	46.25	42.99	53.30	56.67	73.30	75.00	105.00	103.00	70.42
60	$N_3P_2K_3$	113.00	119.00	87.50	60.00	59.00	51.00	52.00	75.00	75.54	98.00	100.00	87.00	81.42
61	$N_3P_3K_0$	75.00	120.00	63.00	60.00	50.00	63.00	70.00	93.96	83.33	66.67	100.00	80.00	77.08
62	$N_3P_3K_1$	103.80	105.00	66.00	70.00	60.60	55.00	60.00	77.00	80.00	92.50	123.00	91.00	81.99
63	$N_3P_3K_2$	80.00	90.00	60.00	66.00	40.50	42.50	38.30	33.00	51.06	79.00	88.00	97.00	63.78
64	$N_3P_3K_3$	85.00	100.00	68.00	52.00	43.30	55.00	66.64	64.42	74.00	72.50	96.54	106.00	73.62
	Mean	98.46	103.32	71.20	61.94	53.86	51.56	55.32	65.96	78.72	89.23	92.50	91.90	76.14
	%CV	14.69	14.23	18.88	16.52	19.12	19.53	20.12	20.58	15.47	14.23	17.50	18.87	9.94

Appendix LXV. ANOVA for effects of fertilizers and their interactions on latex production at site-1 in the 1st year.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	729.405	3	243.135	3.840*
P	344.5742	3	114.858	1.814ns
K	483.561	3	161.187	2.545ns
NxP	3184.281	9	353.809	5.588***
PxK	677.412	9	75.268	1.188ns
NxK	655.655	9	72.851	1.151ns
NxPxK	6171.433	27	228.572	3.610***
Error	7977.393	126	63.313	-
Total	642399.116	192	-	-

*Significant at P< 0.05, *** significant at P< 0.001 and ns = not significant

Appendix LXV1. ANOVA for effects of fertilizers and their interactions on latex production at site-1 in the 2nd year.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	1058.646	3	352.882.	3.30*
P	473.632	3	157.877	1.476ns
K	1307.89	3	435.963	4.078**
NxP	4629.30	9	514.367	4.811***
PxK	797.45	9	88.579	0.828ns
NxK	1631.444	9	181.272	1.695
NxPxK	10686.00	27	395.778	3.702***
Error	13469.394	126	106.90	-
Total	1023820.413	192	-	-

*Significant at P< 0.05, ** significant at P< 0.01, *** significant at P< 0.001 and ns = not significant

Appendix LXV11. ANOVA for effects of fertilizers and their interactions on latex production at site-1 on the average of 2 years.

Sources of variation	Sum of squares	df	Mean squares	F-values
N	738.542	3	246.181	3.764*
P	487.227	3	162.409	2.484ns
K	702.630	3	234.210	3.581*
NxP	3321.711	9	369.079	5.644***
PxK	637.173	9	70.797	1.083ns
NxK	924.841	9	102.760	1.571ns
NxPxK	7448.25	27	275.861	4.218***
Error	8239.621	126	65.394	-
Total	820727.829	192	-	-

*Significant at P< 0.05, *** significant at P< 0.001 and ns = not significant

Appendix LXV111. ANOVA for effects of fertilizers and their interactions on latex production at site-2 in the 1st year.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	969.149	3	323.050	35.126***
P	619.739	3	206.580	22.462***
K	38.358	3	12.786	1.39ns
NxP	387.357	9	43.040	4.679***
PxK	1539.391	9	171.043	18.598***
NxK	562.048	9	62.45	6.79***
NxPxK	3075.389	27	113.903	12.385***
Error	1158.813	126	9.197	
Total	692195.08	192	-	-

***Significant at P< 0.001 and ns = not significant

Appendix LX1X. ANOVA for effects of fertilizers and their interactions on latex production at site-2 in the 2nd year.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	782.36	3	260.787	17.28***
P	674.723	3	224.908	14. 903***
K	213.679	3	71.226	4.7196**
NxP	286.73	9	31.859	2.111**
PxK	1277.254	9	141.917	9.404***
NxK	640.494	9	71.166	4.716***
NxPxK	3899.141	27	144.413	9.569***
Error	1901.525	126	15.091	-
Total	922013.667	192	-	-

** Significant at P< 0.01 and *** significant at P< 0.001

Appendix LXX. ANOVA for effects of fertilizers and their interactions on latex production at site-2 on the average of 2 years.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	861.303	3	287.101	29.033***
P	616.474	3	205.491	20.788***
K	98.166	3	32.722	3.309*
NxP	242.623	9	26.958	2.726**
PxK	1305.672	9	145.075	14.671***
NxK	502.532	9	55.837	5.646***
NxPxK	3344.295	27	123.863	12.526***
Error	1245.992	126	9.889	-
Total	830359.864	192	-	-

*Significant at P< 0.05, ** significant at P< 0.01 and *** significant at P< 0.001.

Appendix LXX1. ANOVA for effects of fertilizers and their interactions on latex production at site-3 in the 1st year.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	176.239	3	58.746	2.672*
P	751.626	3	250.543	11.399***
K	58.92	3	19.64	0.894ns
NxP	1151.874	9	127.986	5.823***
PxK	481.602	9	53.511	2.435**
NxK	557.126	9	61.903	2.817**
NxPxK	2165.966	27	80.221	3.65***
Error	2769.299	126	21.979	-
Total	671551.72	192	-	-

*Significant at P< 0.05, ** significant at P< 0.01, *** significant at P< 0.001 and ns = not significant

Appendix LXX11. ANOVA for effects of fertilizers and their interactions on latex production at site-3 in the 2nd year.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	155.732	3	51.911	2.154ns
P	145.694	3	48.565	2.016ns
K	229.766	3	76.589	3.179*
NxP	1356.595	9	150.733	6.256***
PxK	879.583	9	97.731	4.056***
NxK	1001.11	9	111.234	4.616***
NxPxK	2921.636	27	108.209	4.491***
Error	3036.037	126	24.096	-
Total	1111670.618	192	-	-

*Significant at P< 0.05, *** significant at P< 0.001 and ns = not significant.

Appendix LXX111. ANOVA for effects of fertilizers and their interactions on latex production at site-3 on the average of 2 years.

Sources of variation	Sum of squares	df	Mean squares	F- values
N	171.77	3	57.059	3.258*
P	407.295	3	135.765	7.753***
K	99.924	3	33.308	1.902ns
NxP	1045.69	9	116.188	6.635***
PxK	482.806	9	53.645	3.063**
NxK	635.172	9	70.575	4.030***
NxPxK	1554.269	27	57.566	3.287***
Error	2206.497	126	17.512	-
Total	871953.52	192	-	-

*Significant at P< 0.05, *** significant at P< 0.001 and ns = not significant

Appendix LXXIV. ANOVA for MBCR at site-1 due to fertilizers and their interactions.

Sources of variation	Sum of squares	df	Mean difference	F- values
N	515.537	3	171.686	15913.19***
P	41.181	3	13.727	1271.14***
K	152.391	3	50.797	4703.87***
NxP	1269.394	9	141.044	13060.868***
PxK	208.629	9	23.181	2146.597***
NxK	515.882	9	57.320	5307.942***
NxPxK	3258.795	27	120.696	11176.645***
Error	1.382	126	1.080E-02	-
Total	9214.274	192	-	-

*** Significant at P< 0.001.

Appendix LXXV. ANOVA for MBCR at site-2 due to fertilizers and their interactions.

Sources of variation	Sum of squares	df	Mean difference	F- values
N	90.937	3	30.312	3078.060***
P	201.176	3	67.058	6809.340***
K	39.785	3	13.262	1346.639***
NxP	97.530	9	10.837	1100.401***
PxK	537.091	9	59.677	6059.842***
NxK	141.768	9	15.752	1599.526***
NxPxK	1075.840	27	39.846	4046.128***
Error	1.261	126	9.848E-03	-
Total	6502.294	192	-	-

*** Significant at P< 0.001.

Appendix LXXVI. ANOVA for MBCR at site-3 due to fertilizers and their interactions.

Sources of variation	Sum of squares	df	Mean difference	F
N	35.459	3	11.820	1213.578***
P	287.851	3	95.950	9851.569***
K	93.221	3	31.074	3190.465***
NxP	378.146	9	42.016	4313.966***
PxK	184.554	9	20.506	2105.425***
NxK	186.929	9	20.770	2132.527***
NxPxK	552.272	27	20.455	2100.143***
Error	1.247	126	9.740E-03	-
Total	4681.721	192	-	-

*** Significant at P< 0.001.