UNIT 9 NURSERY AND PLANTING MATERIALS

Structure

9.0 OBJECTIVES

After studying this unit, you should be able to:

- explain nursery management practices in rubber;
- compare brown and green budding techniques;
- describe polybag nursery establishment of rubber; and
- explain how new rubber clones are evolved.

9.1 INTRODUCTION

In unit 8, we discussed about agro-climatic requirements of rubber tree. Do you know that rubber is a perennial tree with an economic life span of over 30 years? Therefore, we have to be careful in ensuring high quality planting materials to raise a plantation. In the early years of the plantation industry in South-east Asia, the main source of propagation was unselected seeds. Later using selected seeds from the best yielding trees, appreciable yield increase could be achieved.

The vegetative propagation of selected high yielding trees by budding on to seedling rootstocks, was developed by van Helton who conducted the first clone trials in Indonesia in 1917. Encouraged by good results, vegetative propagation was adopted by most of the large plantations and slowly, even small holdings started adopting this method of propagation.In this unit, we will study the propagation methods and nursery management practices followed in rubber.

9.2 PROPAGATION METHODS

You should now learn about different methods of propagation. There are two types of propagation methods in *Hevea viz.,* Generative method through seeds and Vegetative method mainly through budding. During the earlier years of the rubber plantation industry, propagation of the crop was through seeds only. Trees raised from seeds are referred to as seedling trees. Since rubber is a cross pollinated species, trees in seedling plantations are not uniform *i.e.,* genetically heterogeneous. Each seedling in a population has a distinct genotype. On the other hand, plants raised by budding from the same source (clones) are genetically uniform.

9.2.1 Seeds

Rubber trees generally produce seeds once in a year though a second round of seed setting is noticed in South-East Asian Countries.

All rubber planting involves propagation from seed whether the seeds are grown to maturity as 'seedling trees' or used as rootstocks for budding.

In early years of rubber cultivation, seeds were collected from seedling areas often described as 'unselected' seeds. Later, seed collection was confined to selected clonal areas. Such seeds are called 'monoclonal' when collected from selected monoclonal areas or 'polyclonal' when collected from specially designed polyclonal seed gardens.

9.2.2 Vegetative propagation

- **Bud Grafting**

The principle involved in budding is replacing the shoot system of one plant with that of another more desirable one. The resulting plant is a two-part tree with root system belonging to the seedling plant (stock) and a shoot system belonging to the superior or desirable plant (scion). The method of bud grafting adopted is a modified form of patch budding. A group of plants derived by budding from a single mother plant is known as a clone.

Depending on the colour and age of the buds two types of budding are mainly practiced in rubber *viz.,* Green budding and Brown budding. In green budding tender green coloured buds are utilized while in brown budding older brown coloured buds are used.

9.3 RUBBER NURSERY

Three types of nurseries are required for production of planting materials to establish a plantation. They are:

- Seedling nursery to generate healthy root stock plants,
- Budwood nursery for generating budwood of superior clones, and
- Polybag nursery for raising advanced planting materials.

9.3.1 Rootstock nursery

Fresh seeds should be used for raising stock seedlings. Since viability of rubber seeds is very short, the normal practice is to place them in Germination bed soon after collection. A well drained area with moderate shade is the ideal site for germination beds. Level beds of 90 cm width and of convenient length are prepared with walking space in between. The bed should be made to a height of 10-15 cm above the soil surface to avoid water logging. A priable material like river sand should be spread above the bed to a thickness of 5 cm. After washing the transported seeds thoroughly, they are spread over the beds in a single layer touching one another, and are pressed gently into the sand. The beds are then covered with a thin layer of gunny bag or coir matting to maintain the required moisture. Germination normally starts within six to seven days. The germinated seeds soon after the emergence of radicle, should be collected daily for planting in the nursery beds. Seeds which do not germinate even after 2-3 weeks should be discarded.

Planting in nursery

Selection of site for establishing ground nursery is important. Ideally, the site should be near a reliable source of water supply on level or gently sloping land with deep well structured and well drained soil. The site should be dug to a depth of 60 to 75 cm and made to produce a tilth suitable for sowing germinated seeds. High fertility levels should be maintained by addition of organic and inorganic nutrients as per the recommendations.

Spacing for planting germinated seeds varies according to the type of the planting material to be raised in the nursery. Spacing for producing seedling stumps is 30 × 30 cm while to produce green budded stumps, the spacing needs be only 23 cm × 23 cm. For producing brown budded stumps, a spacing of 30 × 30 cm is adopted. For budwood nursery the usual spacing adopted is 90 × 60cm or even wider.

9.3.2 Budwood nursery

Superior identified clones as 'budwood sources' are to be raised in separate aites to establish budwood nurseries. These can be such nurseries for collesting buds for both brown budding as well as green budding.

Establishment of brown budwood nursery

One year after planting of budded source plants in the budwood nursery budwoods of convenient length can be harvested for the first time, at 30 cm from the bud union. Two buds on the stump are allowed to grow for the second harvest.

Budwood in the source bush nursery should be cut back every year to allow regeneration of fresh budwood for further budding.

Harvesting, packing and storage of brown budwood

After harvesting, the budwood is cut into pieces of one metre length in which 15-20 buds are available. If there are many clones, the budwoods should be labeled immediately after removal from the plant. The cut ends are dipped in molten paraffin wax to reduce water loss and drying up. Budwood should be utilized as soon as it is collected. If the budding is carried out within the estate, they can be covered with a creepe cover. For local transport, budwood can be covered with banana sheath. Budwoods stored in 20 per cent moist sawdust can be kept up to two weeks.

Budwood nurseries for green budding

Green bud sticks are generated from already existing budwood nursery by cutting back the growing stem 6-8 weeks before budgrafting. Scale buds present on a green bud stick are used for green budding.

Packing and storage of green bud stick

Green bud sticks should be collected early in the morning and used immediately to get the best success. If they are to be transported to far away places, they should be packed in moist sawdust to retain the viability for 3-4 days

Materials required for budding

A sharp knife with 8 cm long blade, polythene tape (bandaging material) and cotton waste for cleaning, are the materials required for budding.

? Check Your Progress 1

Note: a) Use the space below for writing your answers.
b) Compare your answers with those given at the end of this unit.

1) Define clone.

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2) Who developed budding technique in rubber?

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3) What is green budding?

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9.4 BROWN BUDDING

Developed in Indonesia by Van Helton in 1916. Brown budding is carried out by grafting brown coloured buds from one year old scion budwood on to stock plants of 10 -12 months growth. Seedlings with a girth of about 7.5 cm at the base can be used as rootstock for brown budding. Buds in the axils of fallen leaves are utilized for brown budding.

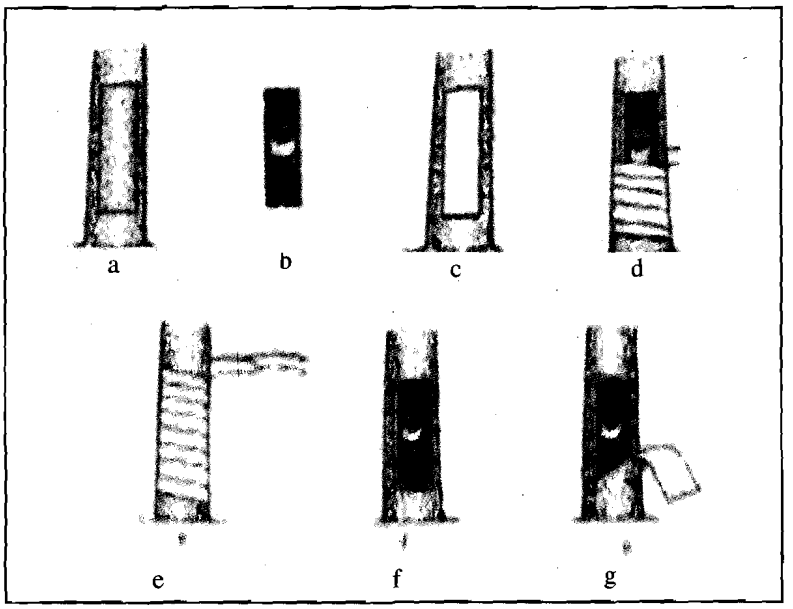

Fig. 9.1: Brown budding procedure

Grafting procedure includes the following steps : Fig 9.1

- Clean the basal region of the plant.
- Make 2 parallel cuts about 1.5 cm apart and 2 cm above the ground level with a sharp budding knife.
- Allow the latex to ooze out from the cut end.
- Remove a budpatch from the budwood. Trim the four sides without bending the bark. The core of the bud should be visible as a slight projection.
- Peel the cut panel on the stock plant and keep the budpatch gently.
- Tie the panel containing the budpatch starting from the bottom, with polythene film of 2.5 x 45 cm and 250 gauge. Bandaging should be tight enough to keep the cambium tissue of the budding panel and budpatch in tact.
- Cambium of stock and bud patch get united within 21 days from grafting. Then remove the polythene tape from the budgrafted region.
- Scrap the bud union lightly with a knife above or below the bud. If the bark in the union is green, initial budding success can be ascertained.
- Examine the budpatch 10 days after the first examination. If the bark is still green, then the budgrafting is successful.
- The plants are uprooted, stumped and transplanted as budded stumps in the filled polybags.

9.5 GREEN BUDDING

Developed by H. R. Hurov in 1960 in Indonesia. If proper agro-management practices are adopted (regular removal of weeds, irrigation, fertilizer application and disease management) most of the plants reach the buddable stage of 2.5 cm girth at collar region, for green budding by 5-6 months' growth. Vigorous seedlings of 2.5 cm girth and brown bark up to 15 cm height, are used as stock seedlings. Scale buds collected from bud shoots of 6-8 weeks old are used for green budding. Budwoods should be used immediately after harvest as it is very tender. (see Fig. 9.2 below).

Grafting procedure

- Make two vertical slits 1 cm above ground level, 5 cm long and 1 cm apart on the stock plant.
- Make a horizontal cut to join the lower ends.
- Remove the budpatch with a section of the wood and carefully separate the bark from the budwood without bending the bark.
- Insert the budpatch inside the bark flap which is cut off leaving 1 cm at the top.
- Tie the budpatch in position with a strip of transparent polythene of 25 cm × 2 cm and 200 gauge.

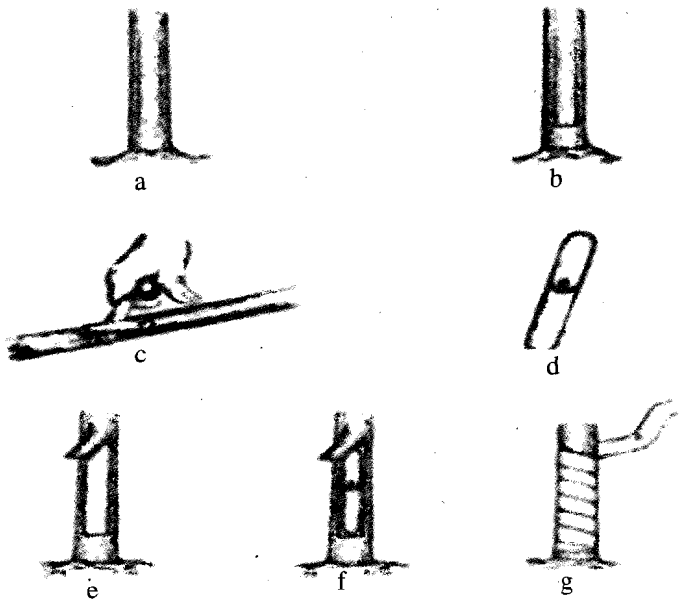

Fig. 9.2: Green budding in Rubber

Examine the budpatch three weeks from grafting. If the budpatch is green in colour, bud grafting is a success. After 10 days the plants can be uprooted, stumped and transplanted as budded stumps in polybags.

9.6 FACTORS INFLUENCING SUCCESSFUL BUD GRAFTING

The following are the impoetant points for successful bud grafting.

- Peeling quality of the stock and budwood is the most important factor for successful budding. The peeling is good when the top whorl of leaves are

well developed. Test peeling of bark 15 cm above the base is the surest method of assessing the good peeling quality of the bark.

- Healthy budwood and stock seedlings are very essential for successful budgrafting process in rubber.
- The best time for budgrafting is up to 10.00 am in the morning and from 3.00 pm in the evening.
- Brown budding gives good success from April to October and green budding from January to March. If there is no rain, irrigation should be provided.
- Use stock plants and fresh budwoods of more or less the same age and girth.
- Damage caused to cambium of the budpatch and budding panel affects the success of budding. Cambium should not be kept exposed to sunlight.
- Nurseries (seedling and budwood) should not be manured one month before budgrafting.

9.7 ADVANTAGES AND DISADVANTAGES OF GREEN BUDDING OVER BROWN BUDDING

Green budding is more fast and easy than brown budding and gives higher percentage of success during summer. Since within one year, two-whorled polybag plants can be produced and planted in the field, nursery maintenance cost is reduced.

On the other hand, field establishment of brown budded plants is easier compared to green budded plants which require more attention during early periods of growth. After harvesting, green budsticks cannot be kept for long period whereas storage period of brown budwood is better. Also green bud sticks cannot be retained in the nursery as over maturity of the bud sticks affect the peeling quality.

? Check Your Progress 2

Note: a) Use the space below for writing your answers.
b) Compare your answers with those given at the end of this unit.

1) What materials are required for budding?

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2) What is brown budding?

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3) What is the best time for budding?

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9.8 BUDDED STUMPS NURSERY

9.8.1 Size of the nursery

One hectare flat land after allowing for inspection paths and drains, can accommodate approximately 75,000-85,000 seedlings. Periodical thinning of weakness results in the availability of about 60,000 for use as stock plants. With 70-80 per cent budding success, it is possible to produce about 45,000-55,000 budded stumps per hectare.

9.8.2 Preparation of budded stumps

To prepare a budded stump, the stem of the budded plants should be cut back at a height of about 7.5 cm above budpatch, on the opposite side of the budpatch. The tap root of the plants should be retained to a length of 35 to 40 cm and laterals to a length of 5 to 7.5 cm. The cut end of the stem is sealed with melted wax for prevention of loss of water content. For transportation, the budpatch is protected by covering with a small piece of banana sheath or folded rubber leaf. For retaining their viability upto 3 days they are tied into bundles and each bundle covered with banana sheath or green leaves.

9.8.3 Polybag nursery for budded stumps

Instead of planting bare root budded stumps in the field they can be grown in polybags in the nursery and transferred to the field either at 2-3 leaf whorled stage or at a more advanced stage of growth. Alternatively, sprouted seeds can be planted directly in polybags and budgraft the seedlings when they are 5 to 6 months old.Advantages of polybag plants are reduction of immaturity period, uniform growth of plants, easy establishment of plants in the field and also checking the identity of clones right in the nursery.

- **Polybag filling**

Black polythene bags are preferred. Bags of 55 × 25 cm with10 kg soil is used for raising plants upto 2-3 whorl stage. For proper drainage, sufficient number of holes should be punched on the bags. Low density polythene sheet of 400 g is usually used. Fine fertile topsoil mixed with 25 g rock phosphate is used to fill the bags, leaving top 2 cm free to facilitate watering the plant. The filled bags can be kept in pairs in the nursery in trenches of about 20 cm deep. Foot path of 75 cm width may be left between two pairs of trenches.

- **Polybag nursery management**

While planting budded stumps in the trenches, the budpatch should face the foot paths to facilitate the growth of sprouts. Regular cultural operations should be adopted. Application of NPKMg 10:10:4:1.5 mixture is done at monthly intervals. During the 1st month, 10 gm mixture is applied per bag which is gradually increased to 30 gm. Care should be taken to prevent contact of fertilizers with the young plants. Fertiliser application is avoided when the leaves are very tender.

9.9 ROOT TRAINER PLANTS - A NOVEL PROPAGATION TECHNIQUE FOR *HEVEA*

Currently, advanced planting materials of *Hevea* are being raised in polybags. In spite of various advantages, polybag plants were found to have certain drawbacks with regard to proper development of the root system and also difficulties in handling the heavy bag plants. The root trainer planting technique was standardized for *Hevea* as a novel propagation technique with a view to overcome some of the drawbacks of polybag plants.

Specifications for root trainers

Plastic containers (Poly Propylene) of appropriate holding capacity of 350cc designed to ensure proper growth orientation of the entire root system are used. Tapering from the top ending in a drainage hole at the bottom the inner wall is provided with several vertical ridges, to ensure proper orientation of lateral roots.

Potting medium

Rotted coir pith mixed with powdered rock phosphate (100 g), neem cake (100 g) and bone meal (100 g) per 20 kg of the potting medium. Fungicide (Dithane M-45 @ 2 g) and pesticide (Phorate-100 @ 2 g)/20 kg is also mixed with the potting medium.

Filling, planting budded stumps and stacking in carriers

The containers of appropriate holding capacity (800cc, 600cc, 350cc) and length (30 cm, 27 cm, 22 cm) may be selected to suite size of budded stumps. First the bottom half of the container is filled tightly with the potting medium. Then place the budded stump in the middle and fill the remaining portion leaving a space of 3 cm. Green/brown budded stumps of moderate size are suitable for raising root trainer plants. Arrange the root trainers in stands made of iron rods (or locally available bamboo splints, wooden reaper etc.) in such a way that bottom of the root trainers remain 3 cm above the ground level for later hardening of the plants. Then stack top soil in between the containers in such a way that the bottom half portion of the container is covered with soil. Those roots growing out of the drainage holes are initially permitted to go into this soil.

Daily irrigation and manuring at weekly intervals with a 2 per cent solution of NPKMg (10:10:4:1.5) is recommended. Water logging in root trainers is to be cleared immediately on observation.

Hardening

In a well maintained nursery, the root trainer plants will attain two whorls of leaves in three to four months. On attaining sufficient growth, the soil put beneath the root trainers can be removed and the roots out grown the container removed carefully with a knife. The root trainer plants are maintained in this suspended condition, off the ground, for eight weeks, for a process called hardening (Fig.9.3). Irrigation, manuring, shading, plant protection etc., are to be continued as mentioned above. In this suspended condition the tap root resumes growth in a few days and undergo natural air pruning near the drainage hole at the bottom of the container. This stress induces emergence of a large number of lateral roots into the well aerated potting medium. The vertical ridges in the container wall direct these roots downwards and thus prevent their circular growth within the container (Fig. 9.4).

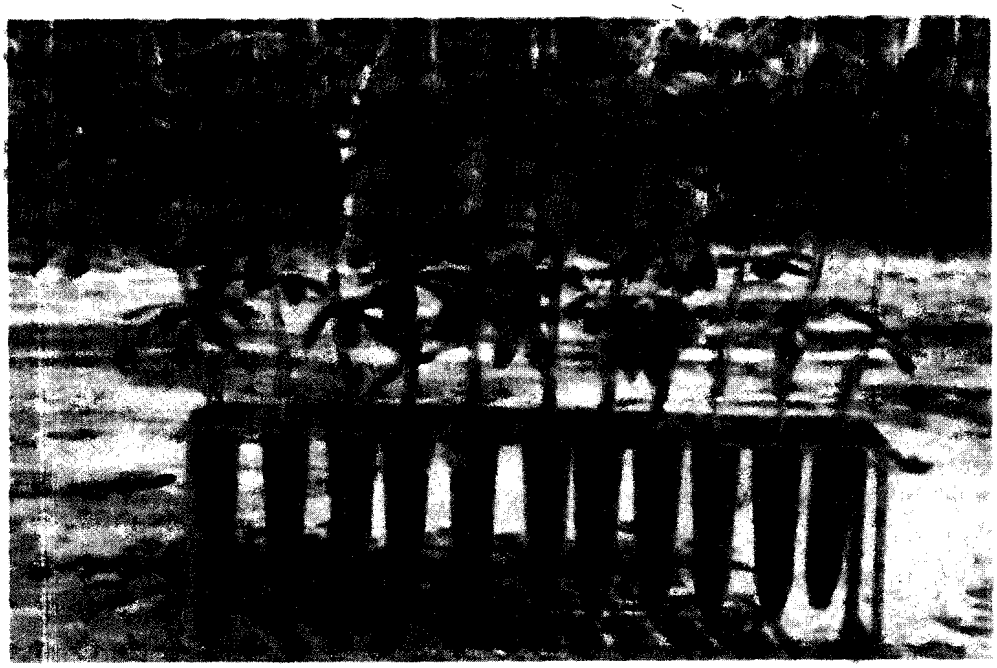

Fig. 9.3: Root trainer plants

Fig. 9.4: Lateral roots

Transplanting to the field

During transplanting, the plant can be detached from the container easily by tapping the upper brim against a hard surface Then the empty container itself can be used to make a planting hole in the refilled pit and the plant inserted in such a way that the bud union remain just above the ground level. All post planting operations are adopted as in the case of polybag planting.

Advantages

- Natural air pruning induces prolific emergence of biologically desirable lateral roots and tap root. Avoids the problem of tap root coiling commonly found in polybags.
- Root trainer plants are sturdier, attain 100 per cent field establishment and higher percentage of tappability compared to polybag plants.

- Root trainers require only around 350-400 g of potting mixture as against 10 to 12 kg of top soil required to fill a polybag.
- Transplanting is easy and quick, thus labour is saved substantially.
- Root trainer planting technique is highly cost effective, economical and environment friendly. Root trainer tubes are reusable.

Check Your Progress 3

Note: a) Use the space below for writing your answers.
b) Compare your answers with those given at the end of this unit.

1) What is the number of budded stumps that can be produced in an area of one hectare?

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2) State advantage of polybag nursery.

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3) Compare the quantities of potting mixture requirement for a) Polybag Plants and b) Root trainer plants.

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9.10 PLANTING MATERIALS

The conventional breeding methods in *Hevea* are introduction, ortet selection and hybridization and clonal selection.

Introduction of clones

Recent introductions of clones were made by bilateral and multilateral clone exchange programs under the auspices of the International Rubber Research and Development Board (IRRDB) and Association of Natural Rubber Producing Countries (ANRPC). So far, 127 domesticated Wickham clones evolved in Malaysia (80), Indonesia (13), Sri Lanka (17),China (3), Ivory Coast (5) Brazil (5), Thailand (3) and Liberia (1) were introduced to India. These clones are being evaluated under the local agro-climatic conditions and promising selections are recommended for large scale planting.

Ortet selection

Ortet selection or mother tree selection also known as plus tree selection, is the

oldest breeding method aimed at systematic screening for outstanding seedling genotypes. Clones developed through ortet selection are called primary clones where parentage is not known. Early primary clones of importance include Tjir1, PR 107, GT 1, Gl 1, PB 28/59, of which GT 1 and PB 28/59 etc., are still widely planted. Currently, over 30 potential ortet clones are under different stages of evaluation.

Hybridization and clonal selection

Hybridization and clonal selection is the most important method of breeding in *Hevea*. This offers scope for exploitation of heterosis or hybrid vigour in progenies of potential parent clones. Clones developed through this method are hybrid clones of known parentage. As a result of hybridization and selection, a good number of hybrid clones of commercial significance has been evolved in different countries. In India, crop improvement programs were initiated in 1954 and a large number of hybrid progeny was developed and evaluated for potential recombinants. The hybrid clones developed by the RRII included RRII 100, 200-300 and RRII 400 series.

Clones - nomenclature

Clones are usually named after the Estates, Institutes or Stations from which they are originated. The abbreviations and full names of some of the clones are given below:

RRII	-	Rubber Research Institute of India.
PB; Gl ; RRIM;	-	Prang Besar, Glenshiel; Rubber Research Institute of Malaysia, respectively.
RRIC/ RRISL;	-	Rubber Research Institute of Ceylon (Sri Lanka)
GT; PR	-	Gondang Tapen, Profestation voor Rubber, Indonesia, respectively.

Recommendation of clones

The planting material recommendation for planting by the Rubber Board is based on long-term assessment of different clones in different agro-climatic situations (Table 9.1).

Table 9.1: Planting Material Recommendation for Traditional Region - 2008

Category I	4 clones - RRII 105, PB 260, RRII 414 and RRII 430.
Category II	8 clones - RRIM 600, GT1, PB 28/59, PB 217, RRII 5, RRII 203, RRII 417 and RRII 422.
Category III	34 clones - RRII 208, RRII 429, PB 235, PB 280, PB 312, PB 314, RRIM 703, RRIM 712, RRIC 100, IRCA130, SCATC 88-13 and others.

Based on the experimental data generated from the North-Eastern Regional Research Stations, a separate planting recommendation has been issued for the region recently as given in Table 9.2.

Table 9.2: Planting recommendation for north eastern region

Category I	RRIM 600
Category II	5 clones- RRII 105, GT1, PB 235, RRII 203, RRII 208
Category III	13 clones- RRII 5, RRII 118, RRII 417, RRII 422, RRII 429, RRII 430, PB 260, PB 310, PB 311, RRIM 703, SCATC 88/13, SCATC 93/ 114, Haiken I and polyclonal seedlings.

Category I consists of clones recommended for large scale planting. Only 50 per cent of the area of any estate is recommended to be planted with any one of the clones in category I. Category II consists of clones with consistent performance at any one of the evaluation stages. It is recommended that three of more of these clones may be used to plant up to 50 per cent of the total area. Category III consists of clones having limited data from experimental planting and recommended not to exceed 15 per cent of the area. Poly clonal seedlings are recommended for planting in marginal areas.

Check Your Progress 4

Note: a) Use the space below for writing your answers.
b) Compare your answers with those given at the end of this unit.

1) Outline the principle involved in propagation by budgrafting.

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2) State the merits and demerits of green and brown budding.

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3) List out the advantages of root trainer planting technique.

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4) Which are the clones recommended for large scale planting in traditional and non-traditional region?

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9.11 LET US SUM UP

- Propagation in rubber is mainly by budgrafting. For proper establishment of planting materials seedlings, budwood and polybag nurseries are to be raised.
- Quality and authenticity of the planting materials are very important since rubber is a perennial crop.
- Two types of buddings techniques *viz.*, brown and green budding, are commercially practiced in rubber. Various favourable factors make budding easy in rubber.
- Root Trainer technique is a novel propagation technique standardized at RRII for development of advanced planting materials in rubber. A process known as hardening leads to development of profuse and healthy root system of root trainer plants.
- Improved clones are developed through crop Improvement programmes through Ortet method and hybridization and selection.
- Planting Recommendations of the Rubber Board consists of grouping clones under three categories; Category I for large scale planting, II and III for limited plantings.

9.12 GLOSSARY

Budwood : Stem of superior plants from which buds are used for budgrafting.

Cambium : Cambium is a layer or layers of tissue also known as lateral meristems, that are the source of cells for secondary growth.

Crown : Leafy upper part.

Harvesting : Cutting and collection of budwood for budgrafting.

Packaging : Keeping the planting materials in suitable medium for better handling, transportation and storage.

Radicle : Primary root.

Rootstock : Seedlings used for grafting of buds taken from the superior plant.

Wickham Clones : Clones developed from the original gene pool collected by Sir Henry Wickham in 1876 from the Centre of Origin of rubber in Brazil.

CHECK YOUR PROGRESS: POSSIBLE ANSWERS

Check Your Progress 1

1) A group of plants developed from a selected mother plant through vegetation propagation.

2) Van Helton, 1917.

3) Budding using green coloured tender buds.

Check Your Progress 2

1) Sharp knife with 8 cm blade, bandaging material (polythene film) and cotton waste.

2) Budding brown coloured buds on one year old stocks.

3) Up to 10 am and after 3 pm.

Check Your Progress 3

1) 45,000 – 55,000.

2) Uniform growth, easy field establishment and easy identification in the nursery.

3) a) 10 to 12kg b) 350 to 400g.

Check Your Progress 4

1) The principle involved in budding is replacing the shoot system of one plant with that of another more desirable one. The resulting plant is a two-part tree with root system belonging to the seedling plant (stock) and a shoot system belonging to the superior or desirable plant (scion). The method of budgrafting adopted is a modified form of patch budding

2) Green budding is faster and easier than brown budding and gives higher percentage of success during summer. Since within one year, two-whorled polybag plants can be produced and planted in the field, nursery maintenance cost is reduced. On the other hand, field establishment of brown budded plants is easier compared to green budded plants which require more attention during early period of growth. After harvesting, green bud sticks cannot be kept for long period whereas storage period of brown budwood is better.

3) Natural air pruning induces prolific emergence of biologically desirable lateral roots and tap root. Avoids the problem of tap root coiling commonly found in polybags.

   - Root trainers require only around 350-400 g of potting mixture as against 10 to 12 kg of top soil required to fill a polybag. Hence very labour friendly.
   - Transplanting is easy and quick: thus labour is saved substantially.
   - Root trainers are reusable and hence the environmental hazards associated with polythene bags can be avoided.

4) RRII 105, PB 260, RRII 414, RRII 430, RRIM 600

SUGGESTED READINGS

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