

VEGETATIVE PROPAGATION OF THE TEA PLANT

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1. THE IMPORTANCE OF THE VEGETATIVE PROPAGATION OF THE TEA PLANT

THE tea plant in natural conditions propagates by means of cross-pollination which is possible between all species and varieties of the tea plant, cross-pollination between the tea plant and some species of camelia even is not-excluded. This supposition occurred to me after the investigation of tea gardens grown from seeds, obtained from the highland region of North-East India. A most intensive cross-pollination is going on in tea gardens between the southern, or Assam, and the northern, or Chinese, species of the tea plant and their hybrids. Our tea gardens are therefore extremely heterogeneous: there may be met with all kinds of variations of the above-mentioned species, varieties and hybrids. In this respect all our plantations are similar to each other independently of the origin of the seed. (Darjeeling, Manipuri and others). Towards the northern limits of tea culture the percentage of hybrids with characters peculiar to southern (Assam) forms decreases and that of hybrids with characters of the northern (Chinese) forms, increases, and *vice versa*: towards the tropics the percentage of hybrids with characters of southern forms increases.

A great many variations are met with among the chief species of the tea plant. They vary as to the colour of their leaves (from light-green to dark-metallic violet), the size and shape of the blade (narrow, flat, etc.), the form of its surface (smooth, rough, etc.), the colour of young shoots, the length of internodes, the ratio of the green to the brown part of a shoot, the duration of the growing period (some forms begin their growth very early in spring and stop it late in autumn, and other forms begin it late and stop early), the immunity to diseases and injurious insects, the frost-resistance, the tendency to produce bhanji shoots, the rate at which shoots grow hard, etc.

These variations influence the quality and productivity of tea gardens. Of course it is desirable to have productive bushes of high quality, immune to diseases and injurious insects. Frost-resistance should be added to the above characters in case of northern or mountain districts.

It has already been mentioned, that our gardens are extremely heterogeneous; besides a great number of bushes with bad characteristics very good bushes are met with though the number of the former may reach 50-98 per cent.

In propagation by seeds it often happens that two plants, the one with good and the other with bad characters grow out of one hole in which 3 seeds have been planted (Plate 1, A and B). Some bushes are frost-resistant and others, when grown in northern or mountain districts, are every year killed by frosts (Plate 2). Besides the above-mentioned kinds of the tea plant, there exist frost-resistant hybrids with characters of the southern (Assam) species (Plate 3A) and those with characters of the northern Chinese species. (Plate 3B).

In order to establish the degree of productivity of these hybrids, we plucked shoots with 3 leaves from 5 year old bushes of different sorts grown under identical conditions. One thousand shoots of each sort were weighed separately, first green and then dry. The results are given in the following table:

TABLE 1

Forms of the hybrids	Number of shoots	Green weight		Dry weight	
		gm.	%	gm.	%
Northern with small leaves	1000	768	100	192	100
Southern with large leaves	1000	1776	232	427	222

In another case 1,000 shoots with 3 leaves of a northern hybrid of a Chinese variety weighed 390 gm. and those with 2 leaves weighed 300 gm. while 1,000 shoots with 3 leaves of a Darjeeling form weighed 824 gm. and those with 2 leaves weighed 520 gm. Investigations have shown that large leaved hybrids give 2.5 — 3 times larger crops than small-leaved ones.



Plate 1.

Two years old bushes of different varieties, grown from three seeds planted in one hole :

- A. A poor variety with small leaves.
- B. A good variety with large leaves.



Plate 2.

A hybrid with desirable characters of the Southern varieties but not frost-resistant (a character of importance in Northern tea regions). Every winter its branches fall off due to frost and every spring it produces new shoots,



Plate 3.

Two forms of frost-resistant hybrids :

A. A productive form of high quality.

B. An unproductive form of low quality.



Plate 4.

Shoots of the same age :

- A. A productive form.
- B. An unproductive form.

The percentage of bushes of low quality in the tea gardens of Georgia is very high, therefore even a partial improvement of the poorest bushes by means of grafting may increase the yields by 160 per cent. approximately.

This increase varies in dependence with the percentage of poorly yielding hybrids in a tea garden. Some kinds of southern large leaved hybrids are remarkable for their growth rate, their productivity and the length of their growing period. Tea gardens which consist of such large-leaved hybrids may produce still larger crops. Plate 4 represents shoots of two hybrids of the same age, 4A — a southern sort with numerous plucking shoots and 4B — a northern Chinese sort of a low productivity. The shoot B has only one point of growth, while the shoot A during the same period of time has formed 6 points of growth (at A, a) owing to its high vegetative power. Obviously yields of the bush A are several times larger than those of the bush B.

Tea growers have to create homogeneous gardens consisting of productive bushes of high quality immune to diseases and injurious insects. It is impossible with the present method of propagation by seeds. Tea plants, like many other cross-pollinating trees and bushes, segregate when propagated by seeds and produce very varied forms; all kinds of combinations between the characters of the parent plants.

Many of these forms (often 50-98 per cent.) possess undesirable characters. The fixation of desirable characters and creation of constant forms by means of usually adopted methods of selection and propagation by seeds takes about 30-60 years. We therefore must try to find other methods of solving the problem, though of course we ought not to suspend our work on breeding constant sorts by means of propagation by seeds. The method of vegetative propagation has been known for a very long time and used in propagating trees and even some annual plants. A great number of first-rate fruit and ornamental plants have been obtained by this method of propagation. Its importance for commercial tea growing is obvious. It helps to increase the productivity of the plantation and the quality of the leaf, to select sorts immune to diseases and injurious insects and to graft tea on stocks resistant to root diseases. This method is matchless for the scientific investigatory work, which requires all factors, but the one under investigation, to be absolutely identical.

In field conditions we have at least two unknown factors: (1) the factor under investigation, and (2) the heterogeneity of the tea bushes. The difference between the yields of the experimental and the control plots may be due both to the factor under investigation (manuring, mulching, cultivation, pruning, etc.) and to the occasional combinations of high-yielding or low-yielding bushes.

Even in our laboratory experiments with plants grown in pots we have to work with extremely heterogeneous tea plants.

Vegetative propagation supplies absolutely homogeneous plants, both for field and laboratory experiments. This method may also be used for growing seed-gardens of the best varieties, and it excludes the possibility of crossings between the good and the bad sorts of the tea plant. Vegetative propagation is of great value in the work of selection for it helps the fixation of the best sorts in a shorter time than is possible from seeds.

2. METHODS OF VEGETATIVE PROPAGATION APPLIED TO THE TEA PLANT

The question of vegetative propagation of the tea plant has not been sufficiently elucidated in literature. Most authors believe it impossible.

In order to decide the question I first carried out a small number of experiments at Sukhum in 1928, 1929 and 1930. Beginning with 1931 I have been carrying out experiments on a larger scale at Ozurgeti-Anasenli, the greatest part of the work having been carried out in 1933-34, when the technical executant of my orders was the gardener Sh. Oragveliodze. All the methods of vegetative propagation were tested, viz.

- (1) different methods of layering,
- (2) propagation by cuttings,
- (3) by buds,
- (4) by root-cuttings,
- (5) budding,
- (6) grafting.

All of the above methods proved to be applicable to the tea plant, simple layering being the simplest and cheapest method of obtaining plants with their own roots, while the best methods of grafting are summer budding in field conditions and winter bench grafting in hot-house conditions.

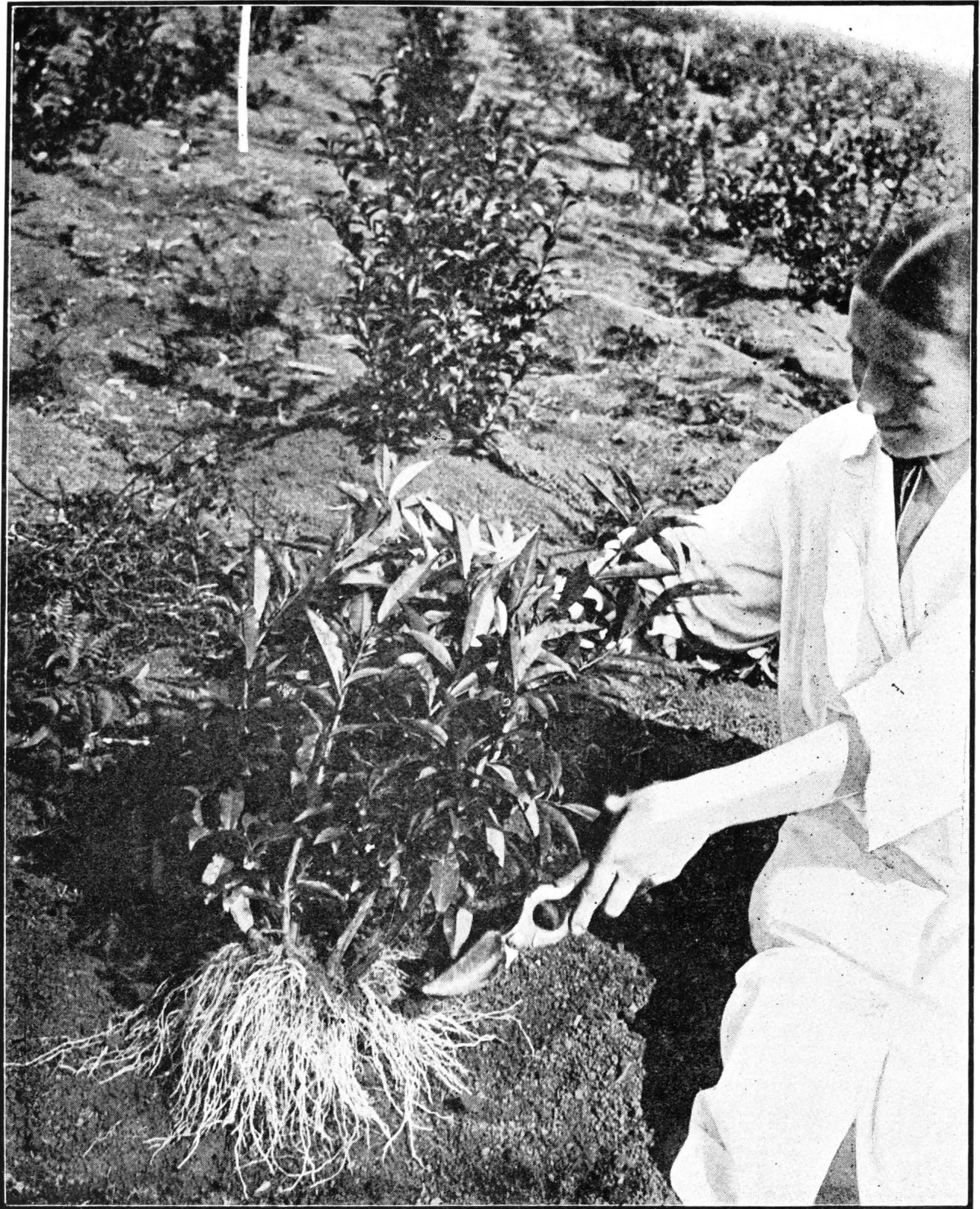


Plate 5.
Simple mound layering.

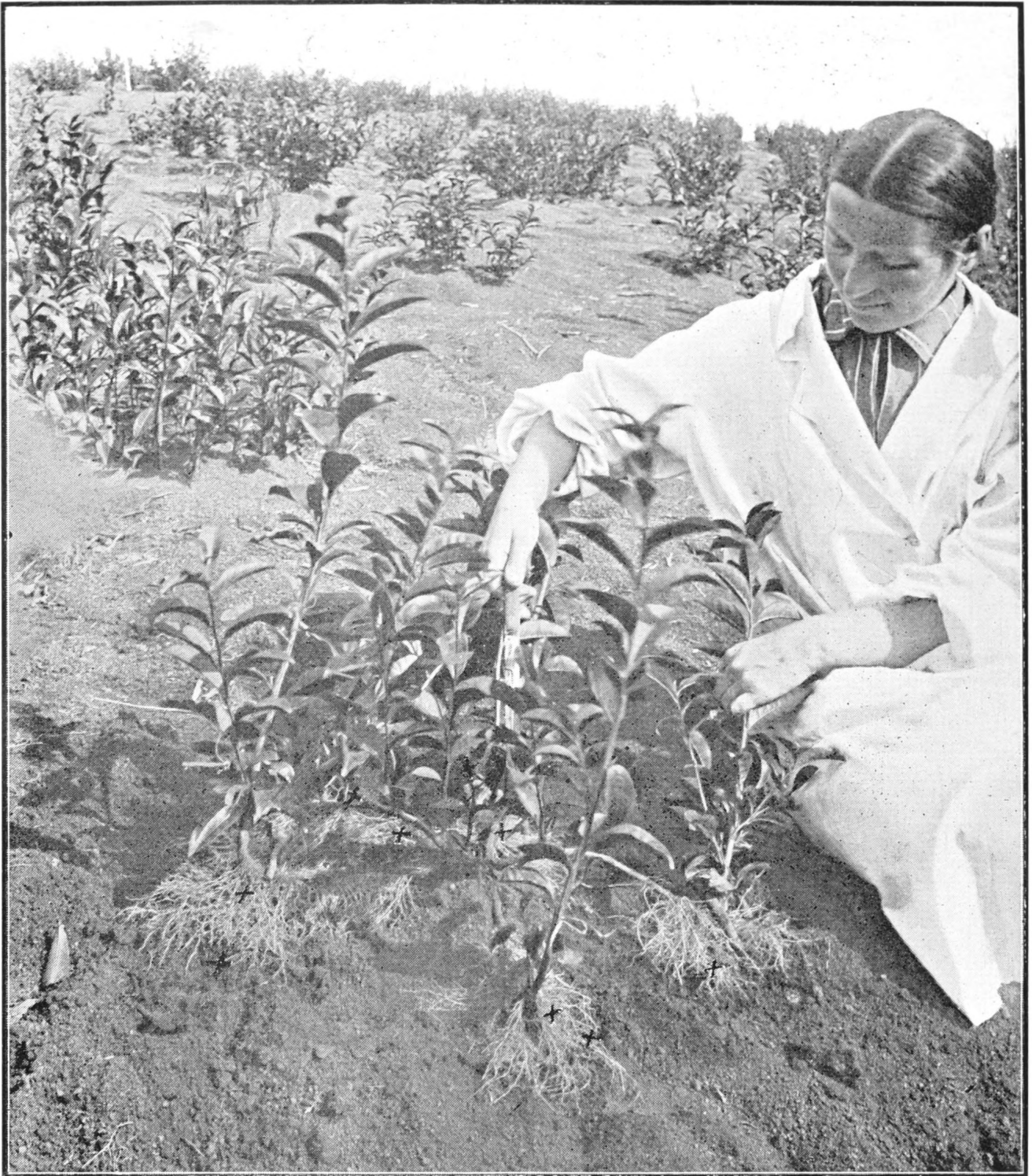


Plate 6.

Simple layering. Rooted layers at the moment of their separation from the parent plant. In the background the parent plant with shoots laid for propagation.

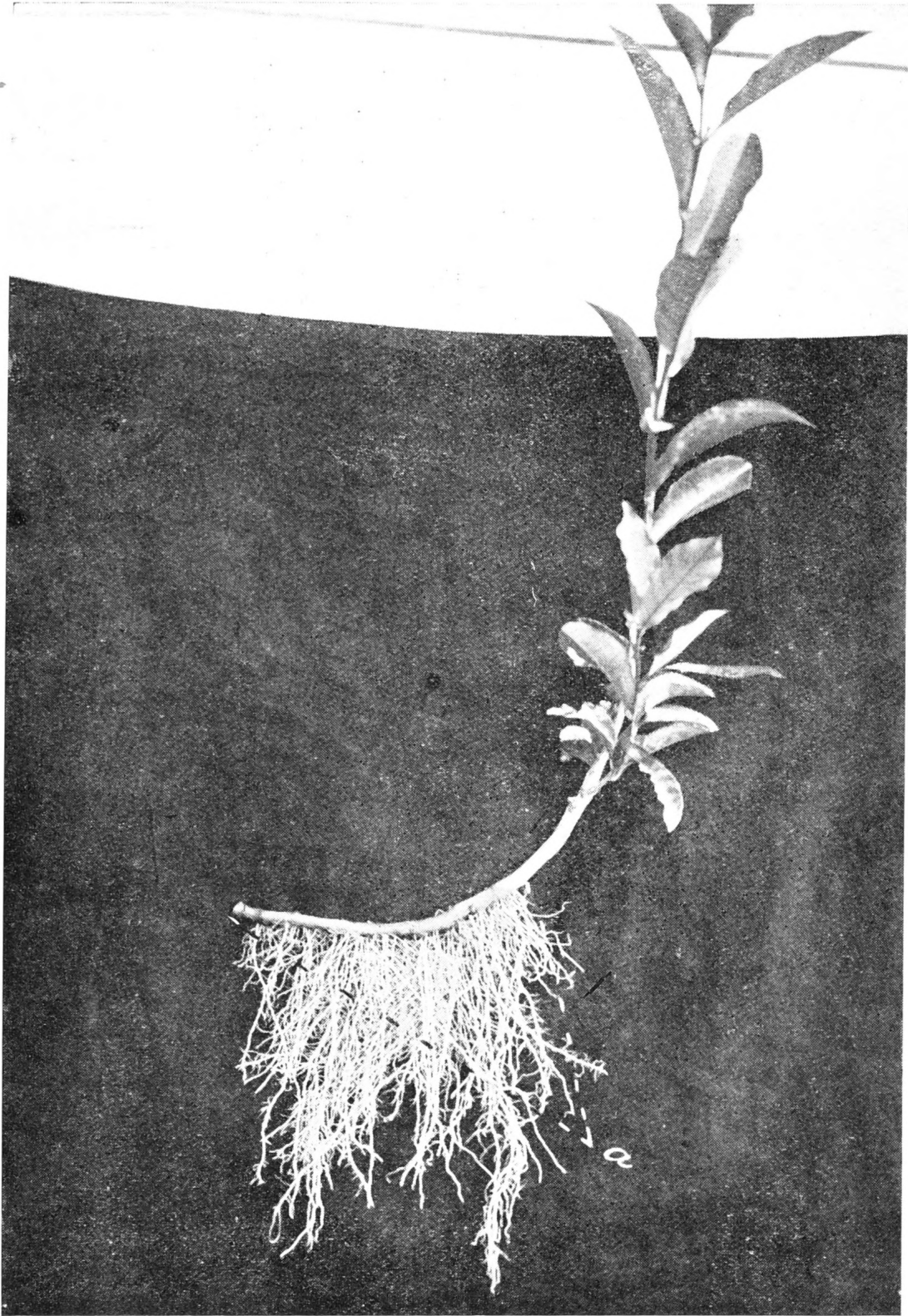


Plate 7.

Simple layering. A rooted shoot, separated from its parent plant and ready for transplantation.

a. Young roots, which developed along the underground part of the shoot.



Plate 8.

Mound layering with ringing. A rooted shoot separated from the parent plant and ready for transplantation.

a. Young roots concentrate at the base of the shoot above the wired place.

3. LAYERING

The following types of layering were tested:

(a) Simple mound layering (Plate 5). The leaves on the lower part of the shoot were removed and the earth mounded round the bush in the usual way *i.e.*, in the same way as in the case of the potato. This method gave satisfactory results (87 to 88 per cent.).

This is the most simple and rapid and the least troublesome method of propagation. Further experiments proved the removal of leaves unnecessary: it does not influence the percentage of rooted plants. Rooting of 2-3 year old bushes took place in 2-3 months after mounding. Plate 5 represents rooted shoots with a great number of young roots. Such shoots may be separated from the parent bush and transplanted into the field. They may be safely used for new plantings.

(b) Simple layering (Plate 6). Branches were bent downwards, placed into small trenches 10-15 cm. long, pegged down in several places and covered with a layer of earth 20-25 cm. thick. The upper free ends of the shoots were fastened to vertical pegs. This method gave also good results (80 per cent. to 90 per cent. rooted plants). Plate 6 represents rooted shoots. Such shoots may be separated from the parent bush and transplanted into the field.

In the background there may be seen parent plants with laid shoots. Plate 7 represents a shoot with young roots ready to be transplanted.

(c) Mound layering with ringing. The shoots are ringed at their base (a ring of bark 2-3 cm. wide is removed) and the earth round the bush is mounded to the height of 25-30 cm. Instead of being ringed the shoots may be wired, *i.e.*, surrounded at their base by several turns of wire.

This method also gave a great percentage of rooted shoots. (81-92 per cent.) Plate 8 represents one of the rooted shoots. Such a shoot is ready to be transplanted into the field.

(d) *Continuous Layering*.—This method consists in pegging down the whole shoot, placed into a trench about 10 cm. deep and 7 cm. wide. The internodes of the shoot are covered with earth and the nodes remain uncovered, as well as the end of the shoot with 3-5 leaves. The young shoots, which grow from the

nodes (Plate 9) produce roots and at the end of the season are ready for transplantation. This method gave 95-100 per cent. of rooted plants. The percentage of rooting is estimated in relation to the number of layers, not to that of the resulting shoots (the latter is much greater). Plate 9 represents young rooted shoots produced by one layer.

(e) *Simple Layering with Wounding*.—This method is similar to that, described in paragraph (d) above, the only difference being a wound made at the base of the layer, at the place where the layer is covered with earth: either an oblique cut is made with a knife and a small piece of wood inserted into the wound, a piece of wood and bark cut off, or the layer is slightly fractured. The percentage of rooted plants attains 94-100 per cent.

(f) *Layering with Wounding and Application of Potassium Permanganate*.—This is similar to that described in paragraph (e) above with the addition of a small dose of potassium permanganate applied as a stimulant. The percentage of rooted shoots, ready for transplantation is 80-86 per cent.

(g) *The Dahlem Method of Layering*.—The bush is cut down at the ground level, the young shoots, which grow out of the bush are wired at the base, when they are 20-25 cm. high and covered with earth, the mound being first made 10-15 cm. high, then heightened when the shoots grow longer, up to the final height of 25-30 cm. This method gave 85-90 per cent. of rooted plants. Table 2 represents the results of our investigations:

TABLE 2

Method of layering	Percentage of rooted plants
1. Simple mound layering	87-88
2. Simple layering	80-90
3. Mound layering with ringing	81-92
4. Continuous layering	95-100
5. Simple layering with wounding	94-100
6. Layering with wounding and application of potassium permanganate	80-86
7. Dahlem method of layering	85-90



Plate 9.

Continuous layer. Young shoots, produced by a single layer.

All methods of layering give a high percentage of rooted plants and every shoot produces a great number of roots, independently of the method used. Special stimulation of root growth (wounding, ringing, wiring, application of chemicals, etc.) is unnecessary. Simple mound layering, the most simple method of layering, can give as high a percentage of rooted plants (up to 100 per cent.) as other methods do. In our experiments it was prevented by unfavourable soil conditions. At the beginning of our experiments we had to carry them out on dry eroded plots where soil conditions hampered the normal development of roots. Later on we continued them on soils with a higher water holding capacity and obtained a far higher percentage of rooting, though the plantation was situated on a slope and heavy rainfalls washed away a part of the earth which covered the layers, leaving some of them quite bare and some covered with a very thin layer of earth; its drying up checked the formation of roots.

In such places, where the soil layer was thick enough (20 to 25 cm.) and contained a sufficient amount of moisture we obtained 100 per cent. of rooted plants independently of the method of layering used. Tea shoots strike root easily.

Bushes round which the earth has been mounded, or which have been covered with eroded soil above their collar produce a number of adventitious roots at any point of a shoot or a branch.

These seven years' observations of the author have shown that the percentage of rooted plants depends upon the age of the shoots and the amount of moisture in the soil which surrounds them. The best results are obtained with one and two years' old shoots (up to 100 per cent.) The soil should always be moist, but the amount of moisture should not exceed a certain optimum, otherwise the want of aeration checks rooting.

No less than 200 bushes were used in each variant of the experiment and each bush was individually characterised. We tried to use similar bushes as far as it was possible with our heterogeneous populations of the tea bush. In general we tried to follow the fundamental rule of experimental work: "all conditions equal, except the one under investigation," though it was not always possible because of the heterogeneity of our tea plantations and an unequal distribution of moisture throughout the soil, due to erosion. We began our experiments in May.

The results of the first year's experiments were summed up in September, those of the following years in April before transplantation, *i.e.*, at the end of one growing cycle. On each bush there were counted shoots, reserved for layering and the percentage of rooted shoots was calculated relatively to their number. Rooting took place in 2 or 3 months after layering, but rooted shoots were not separated from the parent plant before autumn or spring, *i.e.*, before the season of planting.

Besides the above-mentioned, there was tested the Chinese method of layering. Two year old shoots were chosen and placed in vessels (bamboo tubes, broken pots, tins etc.) filled with earth (Plate 10). In autumn the vessels were removed and rooted shoots cut off and planted into the field. Whilst the most troublesome this method gives but 50-70 per cent. rooting because the soil in the vessel dries up without artificial watering.

It is a well known fact that in favourable conditions tea roots produce shoots. In order to obtain as many shoots as possible we uncovered the roots of some tea bushes to the depth of 10 to 15 cm. The same summer they produced shoots. In autumn, or early spring, shoots with pieces of roots were separated from the parent plant and transplanted into the field. This method gives a great number of young plants, but weakens too much the parent plant and is more troublesome than simple mound layering.

At the suggestion of one of my collaborators D.Sh. Eristavi, the method of simple or common layering was used to improve our tea gardens. Up to 1929 tea bushes were usually planted at the distance of 1m x 1m, or 1.25m x 1.25m from each other. Beginning with the year 1929 they have been planted in contour rows or espaliers to prevent erosion. In order to adapt old gardens to these new requirements it was the custom to plant seeds between the old bushes at the distance of 30 cm. from each other with the purpose of obtaining in future continuous espaliers by means of pruning new bushes to a certain form. Plants grown from seeds, as to their development, were far behind the original bushes, while seedlings, transplanted from nurseries, took root but poorly. The method of simple layering gave very good results in obtaining continuous espaliers and is at

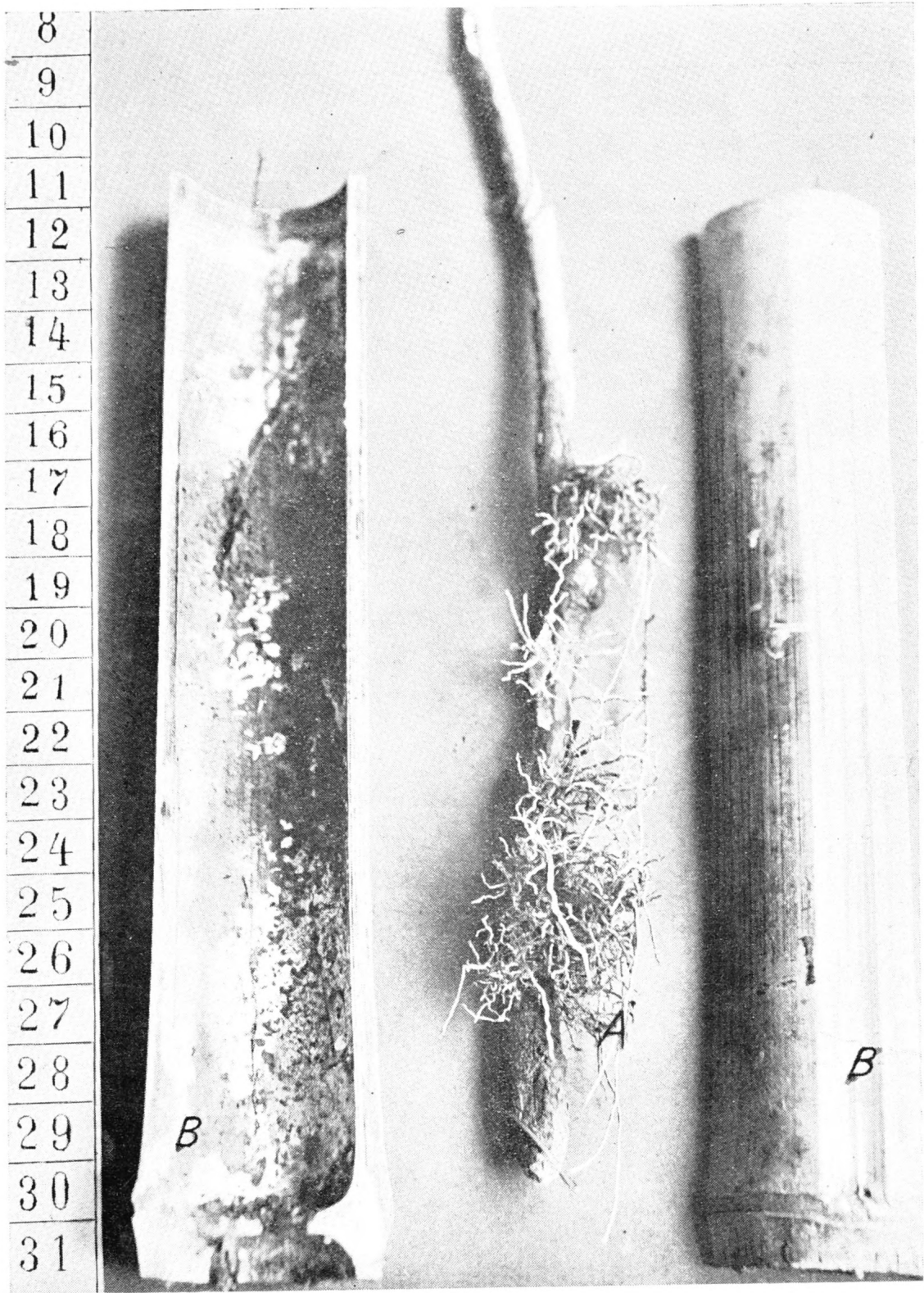


Plate 10.

Chinese layering :

- A. A rooted shoot.
- B. Bamboo tubes into which the shoot is placed before being covered with earth.



Plate II.

Common layering, carried out in order to fill up the gaps in a tea row and to obtain a continuous espalier.

present adopted in our tea industry. Plate 11 represents this method of obtaining continuous rows. A — is the parent plant, B — the young bushes obtained by means of simple layering (laid in May, photographed in September). At present the bushes have fully developed and formed a continuous espalier.

The examination of Table No. 2 shows, that continuous layering gives the best (95-100 per cent.) results, then comes simple layering with wounding (94-100 per cent.) It should be remembered that other methods could be as successful, but were applied in unfavourable conditions due to erosion: the soil, which covered the layers was partly washed away and the rest became subject to drying up.

Bushes, used for our experiments, were 3-5 years old and no difference was noticed in the rooting of their layers. The best results were obtained with 1 and 2 year old shoots, 1, 2 and 3 year old shoots having been used for our experiments. Tea shoots produce roots both in their nodes and along their internodes in contrast with those of some other trees and bushes, which produce roots in their nodes only. A young tea plant (either a seedling or a plant obtained by means of vegetative propagation) usually produces roots below its collar, but in case the collar is covered with earth, a great number of roots are produced above it. Thus the rule, adopted in horticulture, never to plant a tree so deep as to have its collar covered, is not applicable in case of a tea bush.

Beginning with the spring 1932 we have observed the growth of tea bushes, propagated by layers. They were planted on April 17, 1932 in the usual way, the planting distance being 1m x 1m. They did not receive any manuring and were watered but once — at the time of planting. The young plants took root and continued their growth. The percentage of plants, which took root and gave a good growth was as follows: in the case of (1) Simple mound layering 72 per cent, (2) Mound layering and ringing — 79 per cent, (3) Simple layering 60 per cent, (4) Continuous layering 72 per cent, (5) Layering with wounding 66 per cent, (6) Layering with wounding and application of potassium permanganate 68 per cent. It seems natural that all plants, grown out of a layer, once having taken roots and transplanted, should continue their growth independently of the method of layering. The control experiments, carried out the next year — 1933 showed that all rooted shoots, independently of the method of layering, take root well and continue their growth (about 94 per cent, with the exception of a few bushes (about 6 per cent).

The difference between the methods of layering, observed in 1932 was due to soil conditions: the soil, externally absolutely uniform proved to be extremely varied as to its moisture content and fertility. The next year we repaired this mistake and obtained with each method of layering 94 per cent. of vigorously growing bushes.

Seedlings transplanted at the same time from nurseries gave a much lower percentage of rooted plants (30-50 per cent). It is probably due to their producing one taproot and a few lateral roots with an insignificant number of small rootlets, while plants, grown from layers have a great number of small roots and consequently a far larger root surface in contact with the soil.

We also observed the rate of growth of tea bushes grown from layers.

The first (1932) year's figures are as follows:

- (1) Simple mound layering 5-21 cm. average 12·3 cm.
- (2) Layering with ringing 5-22 cm. average 9·8 cm.
- (4) Continuous layering 4-13 cm. average 8·7 cm.
- (4) Continuous layering 6-18 cm. average 10·7 cm.
- (5) Layering with wounding 3-11 cm. average 6·2 cm.
- (6) Layering with wounding and application of potassium permanganate 6-9 cm. average 6·5 cm.
- (7) Check plot 4-23 cm. average 8·9 cm.

There is no marked difference between the check (seedlings) and the experimental bushes, there is perhaps a slight difference in favour of the latter, the average for seedlings being 8·9 cm. and for bushes, obtained by certain methods of layering it is 9·8, 10·7 and 12·3. It is again due to their root system being richer than that of seedlings. It may be said, that both kinds of plant stand transplantation equally well.

A year later (1933) the rate of growth of plants, obtained by means of layering, increased and they soon equalled plants, grown out of seeds, planted in 1931.

Plate 12 represents such a plant, grown in a poor soil. The soil was so poor, that *Ricinus communis*, planted for shade in the spring, attained the height of 5-40 cm. only, while on other soils it grows 150-180 cm. high.

Many specialists in tea growing did not believe vegetative propagation of the tea plant possible.



Plate 12.

A two years old plant : the shoot was laid in 1931, separated from the parent plant and transplanted in June 1932, photographed in August, 1933. (Poor soil : a Ricinus planted for shade developed but poorly).

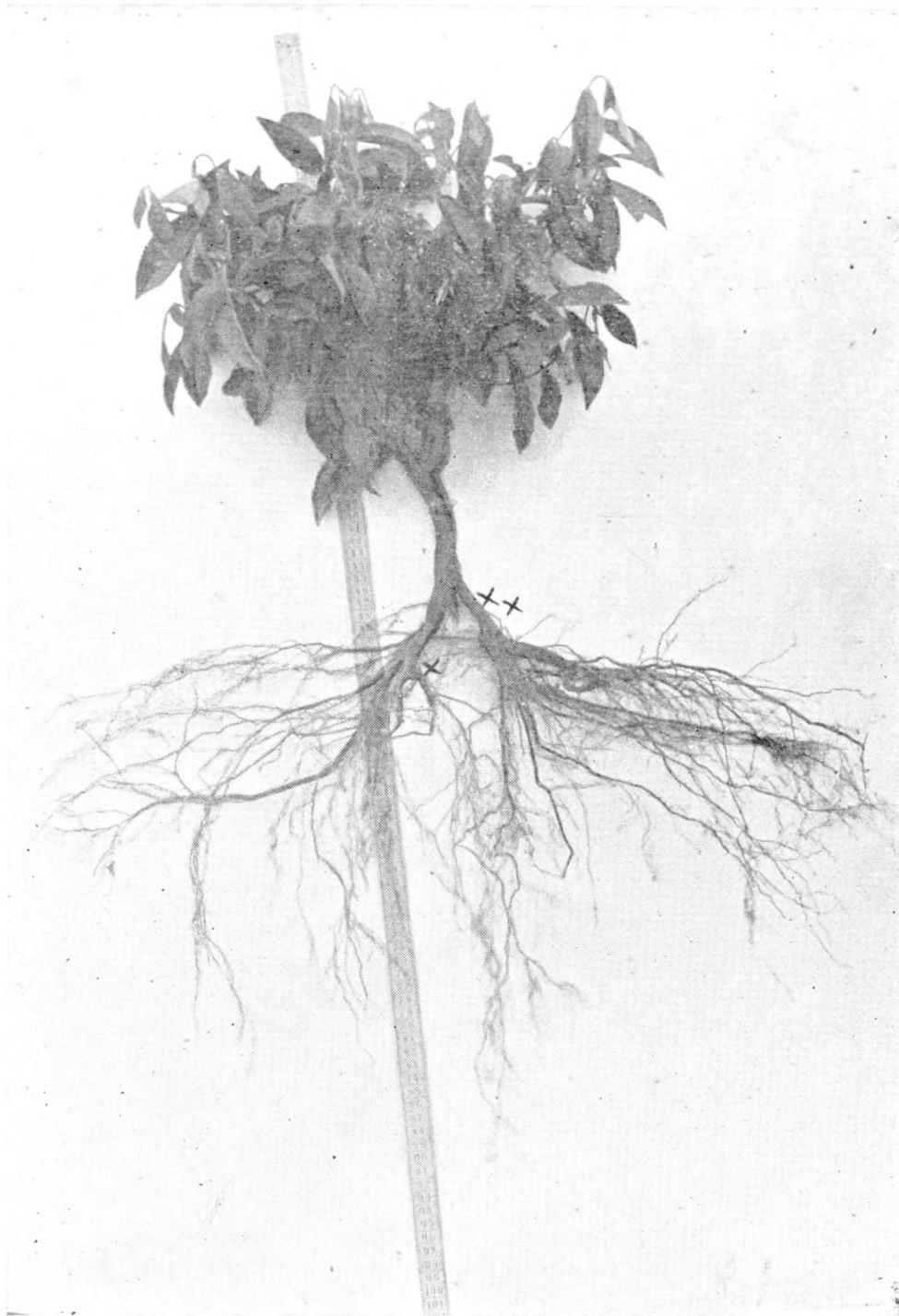


Plate 13.

The root system of a two years old tea bush, grown out of a bow-shaped layer, separated from its parent plant and transplanted in May 1932, dug out and photographed in May 1934.

x. Roots, first produced by the layer.

xx. Roots, produced above the former after the shoot had been separated from the parent plant and transplanted into a deeper hole.



Plate 14.

The root system of a two years old bush, grown out of a wired layer separated from the mother plant and transplanted in May 1932, dug out and photographed in May, 1934. It had possessed a well-developed root system, but fine deep-reaching roots were broken in digging. x.

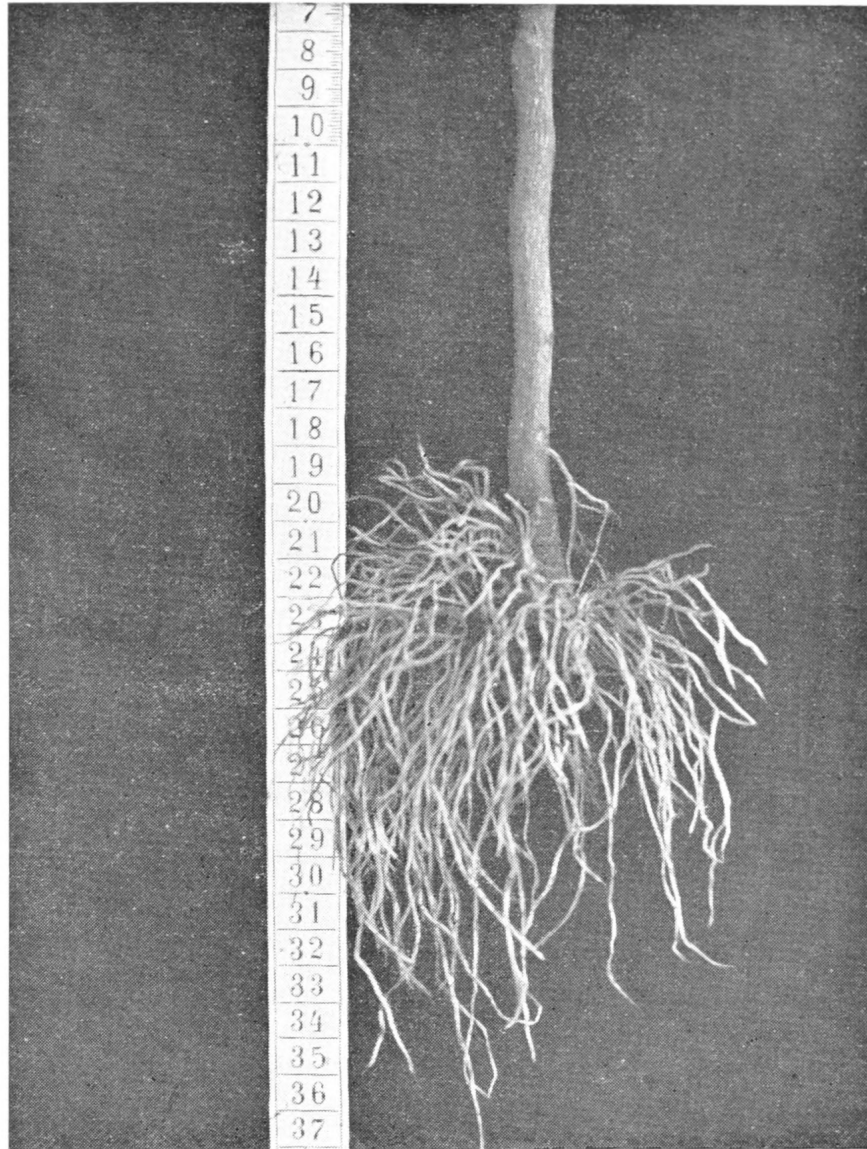


Plate 15.

A straight shoot with numerous roots at its base. This type of root system is obtained by means of ringing, wiring or twisting the shoot.

As to the high percentage of rooted plants they thought these figures to be unreliable because they did not believe this kind of roots to be lasting and thought that later on both the roots and then the plant would die, especially when separated from the parent plant and transplanted into the field. They used to say: "The second stage of the development of a layer or a cutting, the formation of a constant root, is the critical moment of the work; as yet nobody succeeded in obtaining practical results with the only exception of Formosa."

Both plant physiology and practical horticulture show that obtaining primary roots, which absorb water and the nutritive substances it contains, guarantees the development of roots in case the plant is properly cared for. The cause of the failure of other investigators to obtain a permanent root system is the want of proper care and of favourable soil conditions.

We investigated the development of the root system of vegetatively propagated tea plants in field conditions: our observations showed that primary roots may dry up and die off if the bush is planted into a roughly cultivated soil: between single clods of earth, there remain large spaces, where the air may circulate freely and dry up the soil. In such a soil young tender primary roots die of want of moisture.

Before planting young bushes with such tender roots the soil should be thoroughly prepared, especially that part of the soil which will be in contact with the roots; the soil particles must adhere closely to the roots, therefore the soil should be reduced to powder, then pressed round the roots of the plant and immediately watered. The water washes the soil particles down and makes them adhere to the surface of the roots. In case it cannot be done in the field, the young bushes should be transplanted for one year into nurseries. They may be transplanted into the field only after the formation of a developed root system.

Transplantation is carried out in the same way as in the case of seedlings.

Plates 13 and 14 represent the development of the root system of two years old plants obtained by means of layering. After having been separated from the parent plant, in May, 1932 the one year old shoots were immediately transplanted into the field. In May, 1934 the plants were dug out and photographed.

CONCLUSIONS

(1). Tea may be propagated by every method of layering: (a) Simple mound layering (87-88 per cent.), (b) Simple layering (80-90 per cent.), (c) Mound layering with ringing (81-92 per cent.), (d) Continuous layering (95-100 per cent.), (e) Simple layering with wounding (94-100 per cent.), (f) Layering with wounding and application of potassium permanganate (80-86 per cent.), (g) Dahlem method of layering (85-90 per cent.), (h) Chinese layering (50-70 per cent.), and, (i) Growing shoots out of roots.

(2). Both the northern (Chinese) and the southern (Assam) varieties as well as intermediate forms and hybrids are equally easily propagated either by layer or by shoots, grown out of roots. The age of the laid shoot influences the per cent. of rooting. One year old shoots are best for layering.

(3). The water content of the soil influences the rooting of layers. The nearer it is to the optimum, the higher is the per cent. of rooting and *vice versa*.

(4). Tea bushes obtained by different methods of layering stand transplantation well and take root easily (94 per cent.)

(5). They are not backward in their growth in comparison with seedlings.

(6). Layering is the cheapest and simplest method of vegetative propagation (in comparison with other methods which are propagated by cuttings and grafting).

(7). Layering may be recommended for obtaining: (a) uniform commercial plantations of best high yielding bushes, (b) plantations of bushes used for further propagation and of seed gardens consisting of definite good varieties, (c) heterogeneous bushes for experimental field or laboratory work.

PRACTICAL HINTS

(1). It may be recommended to use straight shoots with roots at their base (Plate 15) rather than curved shoots with roots along their underground part (Plate 7). Shoots of the first type show a better power of orientation in the soil conditions and develop their roots in the proper direction, while those of the second type waste their energy in producing a great quantity of roots all along the underground part of the shoot.

Shoots of the first type may be obtained by every method of layering in case they are placed vertically from the base, (the ringed or twisted place), of the underground part (25-30 cm.) up to the tip of the shoot.

(2). One year old shoots for layering should be preferred to older ones.

(3). Of all methods of layering simple mound layering is the cheapest and simplest one.

(4). Ringing, wiring or twisting the shoot stimulates the production of roots and increases the percentage of rooting.

(5). The best bushes, reserved for propagation are pruned in winter or early in spring, before the beginning of the growing period, to the height of 5-10 cm. above the surface of the ground. The same year or the next year in spring the earth is mounded round the newly-produced shoots. In the first case it may be done when the shoots are 20-25 cm. high so as to leave 2-3 leaves above the mound for further growth, later on a second mounding is carried out in order to make the mound 25 cm. high (or the underground part of the shoot 25 cm. long): In autumn or in spring such shoots have produced roots and are ready for transplantation. In the second case the shoots are left without mounding till next spring, when the weak shoots are removed and the earth is mounded round the bush up to the height of 25 cm. from the base of the shoot. Next autumn or spring the shoots may be separated from the parent plant and transplanted into the field. In the second case the whole process takes two years and the best way to obtain planting material for each year is to divide the original bushes into two parts and to prune them alternately; first the one half, and the next year the other. Thus half the bushes produce roots, while the other produce shoots, for the next year's mounding.

A continuous removal of shoots weakens the parent plant, especially when it is done every year, and an intensive manuring, (mineral or organic), is indispensable; especial attention should be paid to nitrogen nutrition of the plants.

(6). In large tea gardens there should be formed plots of best plants reserved for further propagation, which could give material for commercial plantings.

(7). Only shoots with well-developed roots should be transplanted into the field, weaker shoots should be first transplanted into nurseries and later on, after they have developed strong roots, they may be transplanted into the field.

(To be continued).